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APRIL 1936

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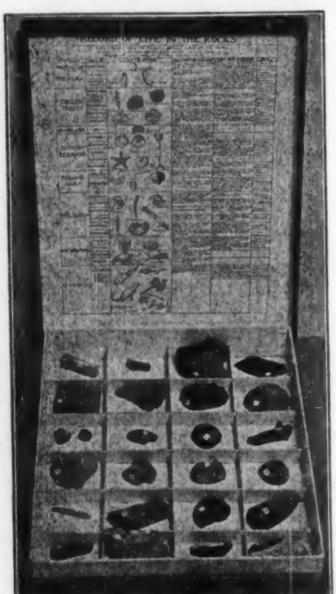

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Science Education

Devoted to the Teaching of Science in Elementary Schools, Junior and Senior High Schools, Colleges and Teacher Training Institutions

Volume 20 APRIL, 1936 Number 2

SCIENCE IN EDUCATION

KARL T. COMPTON

President, American Association for the Advancement of Science

In my brief remarks, I shall deal with two aspects of the subject: (1) the place of science in education and (2) some problems of education in science.

The origins of both pure and applied science are shrouded in antiquity and legend. Some of these legends serve to illustrate a marked difference between the place of science in education then and now. According to one of these legends, the god Hermes, who knew the secrets of nature, used to come to earth in human guise to work in his laboratory. The results of his experiments were placed in vessels which were tightly closed and sealed to keep them from curious eyes. Hence arose the term "Hermetically sealed." By another legend, a group of fallen angels settled on earth and took human wives. They employed these wives to write the secret formulae of science in a great volume known as *chemna,* whence came the names chemistry and alchemy. Today, the press and radio of the world are broadcasting the discoveries of science, and your job as science teachers is to educate the youth of the country in scientific methods and facts.

The contrast is striking. In early days science was secret; its devotees were a secret cult; it was like an aristocracy,—not for the common people. Today, science is an integral part of the daily interest and life of everyone,—science has become a democracy.

Along with this democratizing of science has come an increasing freedom from superstition. The Greeks had made good progress in the transition from superstition to science, when the invasions of Europe by the mid-Asiatics in the early centuries of the Christian era, together with the contacts with the Orient established over trade routes, brought back a long era of superstition which has delayed the attainment of a realistic and rational conception of the world. These superstitions led to belief in the philosophers' stone, witches, and tokens. Even now superstition is not unknown, even among scientists. Two days ago, a well-known scientist, to prove his complete freedom from superstition, said that he always

asked for room 13, or a room on the 13th floor. Apparently, this made him feel better. But there is no doubt that superstitions fade as the light of science grows brighter.

Now this democratization of science and this banishing of superstitions are of enormous significance. I do not dwell on the value of science in increasing productive power, decreasing hours of labor, adding innumerable conveniences to living, banishing disease and bodily discomfort, permitting quick and wide communication of ideas, and the like. These things we all recognize as out-growths of science, and they speak for themselves. But I have in mind a far more important value of science.

Superstition is a matter of the emotions; science is a matter of reason. The conquering of superstition by science is a triumph of reason, or intelligence, over emotion or fear. Such a triumph is, I believe, an absolute essential if a democratic form of government is to be successful. A man whose mind is trained to view situations objectively, to draw rational conclusions from observed facts, to plan his course intelligently in the light of these facts and conclusions, is a man who is a safe citizen in a self-regulating society, *i.e.*, in a democracy. On the other hand, a man who is not trained or capable of thinking rationally, who is governed by his emotions and prejudices, is an unsafe member of a democratic society,—an element of instability.

Let me give a few examples to suggest what I mean. The teachers' oath laws have been sponsored by a group of emotional citizens who believe sincerely in one hundred per cent Americanism. They, therefore, proceed impulsively to allow themselves to get worked up to an emotional pitch over an imaginary situation and to propose a cure which is childishly futile for accomplishing the desired objective. To my mind the teachers' oath bill, in itself, is not harmful except as a nuisance. The serious thing is the fact that so many voting citizens can be so blind to the logical weakness of their case as to take righteous satisfaction in feeling that they have performed a national service. It is the same kind of emotional and mob-psychology which burned witches, drove the pilgrims out of Europe, and has led many nations into useless wars.

Take, again, matters of political or social reform. The rational approach starts with a study and analysis of the situation, and proceeds to search for a solution which will retain present good and eliminate present evil, with careful consideration of results. The non-scientific approach is to try this or that on erratic hunch, to try to perform a miracle as a magician pulls a rabbit out of a hat. The results are likely to be exceedingly costly.

These illustrations could be multiplied, but they will serve to suggest an important aspect of the teaching of science,—the development of the habit and power of thinking logically, of checking theories against facts, and of acting under guidance of reason. Thomas Jefferson, himself a scientist, saw the values of scientific education to a democracy and he "coupled freedom and science as conditions of progress." (Bowman, *Science*, Dec. 6, 1935.) He believed in thinking for himself, saying: "I never submitted the whole system of my opinions to the creed of any party of men whatever, in religion, in philosophy, in politics, or in anything else, where I am capable of thinking for myself. Such an addiction is the last degradation of a free moral agent. If I could not go to heaven except with a party, I would not go there at all."

In these days of complex problems and of increasing tendency to emotional group or mob action, it is more than ever before necessary that our youth be trained to think and act rationally. Science is the best possible training for developing this capacity. Therefore, I believe that it is highly significant that science is now not a secret cult but a matter of universal interest and concern. I, therefore, add this argument to the more common arguments, based on

cultural and practical value, as justification for increased emphasis on science in the programs of our schools and colleges.

The second section of my remarks has to do with a problem of the method of education in science. A rather basic question is: "Which is more important for the teacher, to have thorough knowledge of the subject to be taught, or to have expert training or native skill in the abstract art of teaching?" I shall not answer this question categorically, for obviously both are necessary. I would rather speak of the mode of approach in the teaching of science.

Undoubtedly, the easiest and laziest method of conducting a class in science is to assign a lesson from a text book, quiz the pupils on their mastery of this lesson, and then assign the next lesson. In more advanced university work, an equally easy method is to lecture. Lecturing satisfies the self-esteem of the lecturer, who takes artistic pleasure in the logic and skill with which he covers his subject, and who avoids nearly all contacts with his students which might disturb the perfection of the presentation. Undoubtedly, also, these are the world's worst methods of teaching science. A real science teacher is far more than a taskmaster or a stoker, and science does not consist of learning lessons by heart or taking notes. In fact, an argument can be made that the habit of learning, by memory, with which so much of our education is concerned, is a handicap rather than an asset to real mastery of the method and spirit of science.

Science is not a technique or a body of knowledge, though it uses both. It is rather an attitude of inquiry, of observation and reasoning, with respect to the world. It can be developed, not by memorizing facts or juggling formulas to get an answer, but only by actual practise of scientific observation and reasoning. The teacher, to be effective, must have the same attitude as the pupil, after the method of Socrates.

There is no stimulus like the joy of discovery, and it is often a wonder to me that any interest of students in science ever survives the year upon year of learning to which they are often subjected without ever tasting the joy of an original discovery or idea, however elementary. There is all the difference in the world between running a laboratory to verify the laws that have been learned in the text book and running it to bring out or suggest these laws in advance of the text book. The latter method is slower, and far more difficult for teacher and pupil alike; but the former method is not really science at all,—merely illustration and technique.

I have occasionally known teachers who really did scientific work with their pupils, and never once have I known it to fail of results. It is often said that elementary teaching in science is a highly developed art, whereas teaching on the higher levels, in the graduate schools, is very poorly done. It is also generally believed that teaching becomes more difficult in the higher levels. I think, in a way, both these statements are wrong. The best and also the easiest teaching is done by the professor who is working with his graduate student on a research problem. Here all thought of pedagogy is thrown to the winds; the teacher and student are collaborators on a job that taxes the resources of both. The student learns by example and by his own mental effort.

Now, I perfectly well realize that I have presented an exaggerated case, and that there is a great deal to be said for training of teachers in educational methods. But I firmly believe that no element in the training and environment of science teachers is so valuable as that which keeps them in continual live touch with the progress of science itself so that, through their own interests and example, their students may see science as a live subject and feel that they share some part, however significant, in its progress. This is a continual challenge to the best ingenuity of science teachers and a guide as to those activities and contacts which will be of greatest value to them in their teaching work.

THE PREPARATION OF HIGH SCHOOL SCIENCE TEACHERS IN TERMS OF THE MARKET*

Ralph K. Watkins
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In the presence of our existing development of technology we are continually faced with the problem of usable, but obsolete, machinery. Any person yet driving an automobile made before 1930 is aware of this problem. The industrialist with much money tied up in out-of-date machinery is more keenly aware of it.

Much more serious than obsolescent machinery in social consequences are the trained human beings left by the wayside because of changes in technical processes, —the so-called improvements of our present world. All of the people in the printing industry are confronted with needs for readjustment due to the fact that their whole industry seems to be moving rapidly away from printing with type toward photographic processes. Even the position of the college professor has been threatened by the talking picture. Perhaps the college professor of the future will need to seek shelter under the wings of a bureaucracy.

Changes in technical processes produce changes in the market for trained workers; so do changes in social conditions and social ideals. At one time the insurance companies and bond houses absorbed a certain number of the graduates of the football curriculum of our colleges. To-day there is a market for the best of these graduates with professional football teams in the entertainment field. In a more serious vein, our present social situation has increased the market for trained social workers.

Any institution engaged in the training of professional workers must be keenly aware of fluctuations in the market for its product. It is possible that law schools need to give more attention to the training of specialists in divorce and income tax entanglements, and to specialists in constitutional law than they did 20 years ago. Medical schools of the future may need to train physicians and surgeons to serve as specialist members of clinics set up by city and state agencies to serve the public.

This paper is concerned with the market for just one small division of a trained professional group, and with the type of training needed by these people to meet the demands of the present market. The professional group is that of high-school teachers. The division is that of science teachers.

The people entering school teaching become sensitive to the range of opportunities for teaching in particular lines. They must become aware of the demand or join the ranks of the unemployed. The teacher-training institutions have been usually much less sensitive to changes which affect the demand for teachers. Changes in the curricula for training teachers often lag far behind the changes in the organization of the schools which these teachers are to serve. This seems to be the general condition in the training of high-school teachers in science at present.

The American high school was standardized upon the pattern recommended by the Committee of Ten in 1893. The predominant high-school pattern of natural sciences contained in these recommendations consisted of physical geography, physics, botany or zoology, astronomy and meteorology, and chemistry. This pattern fits the pattern of established science departments in colleges and universities. All that seemed necessary to train a high-school-science teacher was to have the person being

* An address to Section Q of the American Association for the Advancement of Science, St. Louis, December 31, 1935.

trained specialize in the college-science department of his choice. He could then go out and teach this same speciality in a high school. No consideration was given to the fact that the relatively small high school could not employ the full time of such a specialist in teaching his speciality alone. We have, therefore, had developed the most weird layout of accidental teaching combinations that could possibly be devised. More often than not these have been combinations of a special science with some unrelated subject, rather than combinations among the several sciences.

In the 40-year period since the Committee of Ten there has occurred the amazing democratic expansion of the American high school. Whether or not this is a desirable expansion is not an issue in this paper. With this expansion came changes in the curricular content of the high schools. From about 1915 general science and general biology began to replace physical geography, botany, and zoology in the high-school program.

In 1920 the Committee on Science of the Commission on the Reorganization of Secondary Education recommended the following sequence for four-year-high schools: general science, general biology, physics, and chemistry. Now the predominant high-school sciences in frequency of offering and in the numbers of pupils enrolled are general science and general biology.

It would seem obvious that a teacher trained in one science as a specialist cannot deal adequately with either general science or general biology. The desirability of these two courses is not subject for debate here. They are offered in high schools and our science teachers going out from colleges and universities must be able to teach them.

Slowly and grudgingly, teacher-training institutions have come to the offering of majors in general science and general biology. In most cases people working on these majors are specialists in such fields as physics, chemistry, botany, or zoology, who add to the speciality enough other subject matter to meet the minimum requirements for the more general major. This presents certain problems, but is not the whole problem.

Our present situation is that we are training specialists for jobs that no longer exist. For example, a college student with the declared professional intent of high-school teaching is permitted to specialize in zoology or botany, occasionally in geology.

TABLE I

Patterns of Science Combinations Offered in First-Class Missouri High Schools for the School Year 1934–35

Science Combination	*No. of Schools Offering*
General science, only	116
General science and biology	87
General science and physics	46
General science and hygiene	42
General science, biology, hygiene	36
General science, biology, physics	35
General science and physiology	26
General science, biology, physics, chemistry	16
Hygiene only	14
General science, physics, physiology	13
Physics, only	13
Biology, only	12
Biology and physics	12
General science, physics, hygiene	11
Biology and hygiene	10
General science, biology, physics, chemistry, hygiene	8
Physiology, alone	8
General science and chemistry	7
General science, biology, chemistry	6
General science, physics, biology, hygiene	6
General science, biology, physiology	6
General science, hygiene, physiology	6
Physics and hygiene	5
General science, biology, physics, physiology	3
Physics and chemistry	3
Chemistry, only	3
General science, biology, physics, chemistry, physiography	3
Biology and physiology	2
General science, hygiene, and chemistry	2
General science, biology, physics, chemistry, and physiology	2
General science, chemistry, physiology	2
Biology, physics, hygiene	2
Other varied combinations of science subjects occuring in only one school	30

On the present market there is practically no demand for high-school botany or zoology teachers. Students are permitted to make majors in biological sciences with no training in the physical sciences. Our teacher-training program for the high schools of 1935 is largely governed by the ideals of science teaching of 1890. What kind of teacher training does the present high-school science program demand?

TABLE II

Subject Combinations Actually Carried by Science Teachers in 1st Class Schools of Missouri 1934–35

Subject Combination	*No. of Teachers Teaching the Combination*
General science and mathematics	65
General biology, alone	58
General science, alone	52
Physics and mathematics	30
Physics, alone	26
Chemistry, alone	26
General science, physics, and mathematics	25
General science and biology	21
General science and agriculture (?)	18
Hygiene and physical education (?)	18
Biology and mathematics	14
General science and social studies	14
General science and physics	14
General science, mathematics, physical education	13
General science, biology, mathematics	13
Hygiene, social studies, and physical education (?)	12
General science, social studies, physical education	11
Science	11
Biology and vocational agriculture	10
Biology and social studies	10
General science and physical education	9
Physiology and German	9
Physics and chemistry	9
General science and English	8
Biology and English	8
General science, mathematics and social studies	8
General science, biology, mathematics and physical education	8
Physiology, alone	7
General science, biology, physics	7
General science and chemistry	7
General science, social studies, geography	7
General science, biology, and physical education	7
General science, mathematics, and agriculture	7
Hygiene and social studies	6
General science and commercial subjects	6
Chemistry and mathematics	6
Physiology and social studies	6
Physiology and physical education	6
Biology and chemistry	6
Biology and physical education	6
General science, physics and social studies	6
General science and music	5
Hygiene and English	5
Zoology, alone	5
General science, social studies, commercial studies	5
Hygiene, geography, social studies	5
General science, biology, chemistry	5

Various other combinations carried by 2–4 teachers representing 181 different teachers, 72. One hundred nineteen different combinations of subjects carried by 2 or more teachers.

In order to find out what science teaching jobs actually exist in high schools today, a study was made of the patterns of sciences offered in Missouri high schools of the first class for the school year 1934–35. The data were obtained from the Missouri High School Directory for 1934–35 issued by the State Department of Education. Five hundred ninety two high schools are included in this study. These are all of the first-class high schools for which such data were available.

The patterns of science combinations actually offered in Missouri high schools in 1934–35 are shown in the accompanying table. It will be noted that 116 of these schools offer only general science. This is more than one-sixth of all the schools studied. Of all the patterns offered by two or more schools, 490, about 87 per cent, contain general science. Two hundred forty six, 43 per cent, of these patterns contain the general biology course.

If we assume that science teachers may be trained more economically to carry all of the sciences offered in a moderate-sized high school, obviously there is almost no market for the specialist as a high-school-science teacher in Missouri.

The pattern of sciences offered in the high schools is not, however, the basis for determining the science combinations ac-

tually carried by the teachers. There are in the schools surveyed 62 different patterns of science combinations offered. There are 119 different subject combinations, which contain some science, carried by two or more teachers in these schools. These include combinations among the sciences and combinations of sciences with other subjects. The nature and frequency of these combinations in Missouri in 1934–35 is shown in the second table.

From this it may be seen that there were in this year opportunities for the following numbers of teachers of special sciences: physics 26, chemistry 26, physiology 7, zoology 5. In addition there were two teachers who taught only hygiene.

Opposed to this are the following more generalized combinations of sciences that are actually being taught by teachers in Missouri: general biology 58; general science 52; general science and biology 21; general science and general agriculture (?) 18; general science and physics 14; science (unspecified) 11; physics and chemistry 9; general science and chemistry 7; biology and chemistry 6; general science, biology, and chemistry 5.

Of the more frequent (those carried by 5 or more teachers) actual combinations in Missouri high schools for teachers teaching sciences only, 64 are special sciences. Contrasted with this 201 teachers are teaching general science, general biology, or combinations of sciences. It seems evident that the predominant market for science teachers is for teachers who know more than one science.

Without going into statistical data, it is known that the opportunities for teaching single special sciences exist almost wholly in large city high schools. These positions are held by mature, experienced teachers, most of them of long tenure. The turnover in these positions is very slow. The young graduates of our teacher-training institutions must begin work in relatively smaller high schools and perforce teach combinations of subjects; if not combinations of science subjects, combinations with mathematics, or with almost any other subjects offered by high schools.

It would seem that the necessary solution to the problem presented is for teacher-training institutions to abolish majors in special sciences for prospective high-school teachers and to substitute therefor a single major in natural science. This major should be so composed that a graduate of such institutions would be able to teach the general science and general biology and other sciences commonly offered in the patterns of science combinations found in the high schools. (See Table I.)

Such a major would be large in comparison with the present minimum academic major of 24 semester hours in one science. Students might well be expected to devote approximately 60 semester hours of undergraduate work to training in the sciences. If 20 semester hours are allowed for professional courses in education, the student would still have 40 semester hours, or one-third of his undergraduate program, to devote to general cultural courses outside the sciences. Some part of this remainder could be devoted to work in a minor field, such as mathematics. (See Table II.) The present minor requirement for teaching mathematics in Missouri high schools is only 15 semester hours.

One of the objections most frequently made to a broad generalization of the training of science teachers is that the teacher so trained has not sufficient training in any one field to continue graduate work in any one science in a university science department.

The suggested 60-hour major is large enough to include the 24 hours of an academic major in one science and a considerable training in other sciences as well. The student should be advised to set up his personal program in such a way that he has enough training in the science of his greatest interest to be able to continue graduate work in that line if he desires.

We are not now training science teachers

for the work that is to be done in the public high schools. The program outlined would go far towards mending this situation. Your speaker believes that the program proposed would raise the standard of science teachers and science teaching. We should have better science teachers, even of special subjects. If a young teacher abandoned secondary-school teaching to become a specialist in some one science, he should make a better scientist because of his broadened early training.

More important than this, the pupils in the high schools would have the opportunity to learn some science through having teachers sufficiently trained to help them.

LIGHT AND SMOKE FROM THE TORCH OF SCIENCE*

Benjamin C. Gruenberg

Associate in Science, American Association for Adult Education

Both science and education can be preeminently practical, for both enable us to carry out our purposes on the basis of past experience.

Education, which is the older social invention, is an effort to make past experience more widely available by transmitting it to the less experienced—young people, for example—in a fraction of the time they could acquire similar experience at first-hand. Science is a method of concentrating, evaluating and refining experience so that we may guide our conduct with a wider range of principles, and more reliable principles, than mankind had mastered in the past, through trial and error.

These two powerful time-savers have made possible the staggering social changes of the past two or three generations. Both education and science, as social preoccupations, have expanded, and they have interacted to their mutual advancement.

I

It is common knowledge that the sciences have made great inroads into the high-school and college curricula, and that they are steadily invading the elementary schools. And it is commonly assumed that the extension of science (as a subject of instruction) must make for a more and more "scientific" public mind.

The important feature of science, that is the feature that makes science important enough to be included in a program of universal education, is its methodology, the spirit of inquiry, the critical reexamination of postulates as well as of conclusions. It is this spirit that has enabled us to use science in the solution of numberless practical problems, that has made possible the achievements characteristic of the age, although as President Angell pointed out in a recent address, "It is unwarranted flattery to call ours the age of science."

The urge to doubt and to wonder, which is sometimes expressed by the irreverent in the query, "Oh, Yeah?" leads to testing, to criticizing, to exploring. And it leads also to whatever certainty we have, so far at least as concerns the control of the materials and forces of our environment. In spite, however, of yielding this rather high degree of certainty, science is constantly beset by further doubts, it is constantly aware of the limitations in its knowledge. Even after the physicist has enabled the engineer to construct mechanisms weighing many tons but operating with the delicacy and narrow "tolerances" of fine watches or other precision instruments, he is fretting about the next decimal place. In fact, a distinctive part of the scientific achievement, that which has to do with the reduc-

* Presented before Section Q, Education, of the American Association for the Advancement of Science, Pittsburgh, December, 1934; under the title, "Conflicts Between the Methodology of Science and Educational Practice."

tion of knowledge to mathematical form, itself calls attention to the limitations of our knowledge. To be satisfied with a generalization that is only, let us say, 80 per cent valid, enables one to make out; that is, in practical affairs he is substantially better off than a random guesser. But to discover that a subtler generalization is only 98.7 per cent reliable at once challenges the scientist to go a step farther.

II

In contrast to this restless spirit is the normal outcome of teaching efforts. Teaching, from its very beginnings in prehistoric times, must always have been a process of telling, of imparting "truth" of various kinds. The more experienced can pass on the benefit of what they have learned—better ways to make weapons or to stalk game, how to distinguish the red berries that bring pain from those that bring pleasure, the thousand tricks in each of the hundred practical arts, as well as the rituals and ceremonies necessary to gain the favor of the good spirits and to propitiate or escape the evil ones.

The need for improving techniques has long since placed science at the service of the military, of agriculture, of industry, of government, of commerce, of transportation, of every practical art. The early experimental psychologists seem to have had some hope that science could be made to help in the practical arts of education and statesmanship. Certainly the psychology as taught in the teacher-training institutions for more than a generation past was assumed to contribute to better, that is, more *efficient,* teaching. More recently, as suggested, the scientific attack upon educational problems has come to be a part of standard practice. Here then we should expect that a fusion of two techniques and two sets of practical purposes would result in a mutual reenforcement, an enrichment of both.

Since the war there has been an increasing amount of literature in the form of special papers and dissertations based on the scientific study of various problems of education and of pedagogy. One of the postulates that appears frequently to be implicit, both in these studies and in the views of the scientists and science teachers, is the possibility and the desirability of standardizing educational practice as a result of such inquiries. The studies have to do largely with curriculum, selection of material, grading of content, and methods of instruction. As to the curriculum, teachers of science seem to seek for the most significant or useful items to be included in the syllabuses, and to be groping toward agreement on what may be called minimum essentials—both as to the amount of time allotted, and as to the topics to be included. In the further study of curriculum problems there have been attempts to analyze contents for grade placement, for sequences within the grades, and to seek generally acceptable plans for nation-wide, certainly state-wide, application.

In the study of methods of instruction there has been a great deal of experimenting with text material and laboratory manuals and work books and lectures and demonstrations and motion pictures and radio and supervised study and library browsing. All of these experiments and studies started from carefully formulated problems, they followed the scientific methods of assembling and classifying facts, formulating hypotheses, and proceeding to validate, revise, or repudiate these hypotheses.

One generalization stands out from the examination of a large number of these studies, and from interviews with many investigators and directors of investigations. That is, in very, very many cases teachers of science and scientific students of education have been carried away by the workings of an important device in almost complete disregard of what it is all about.

Let me illustrate with a few examples. A rather extensive study of the emotions in young children has among its conclusions the remarkable discovery that "the intelligence of the child tends to increase as the

number of siblings decreases." An ordinary statistician might be content to say that he finds a negative but significant correlation between the intelligence quotient and the size of the family, or the number of siblings. But in the effort to be "practical" as educational scientists we have let ourselves be betrayed into speaking of "tendencies" and other dynamic categories. The author does not recommend, as a practical means of raising the population's I.Q., the elimination of all siblings, not even their decimation.

Another type of statistical study is represented by the gathering and analyzing of *factual* information about vocabularies, about the contents of books or of syllabi, about questions in examinations and so on. In many such studies the tacit major premise seems to be that the facts thus disclosed furnish adequate guides to standard practice. The investigators have not always attempted to convert statistical averages into normative principles; but neither have they always protected the teachers who are supposed to benefit from such studies against making the conversion.

An example that has become classic through wide and continued exploitation is the systematic comparative study of the earnings of college graduates, of high-school graduates and of elementary school graduates. The earliest of these studies, made some forty years ago, showed a high correlation between the number of years given to formal schooling and the annual earnings at any specified age, say from thirty years on. This "scientific" information was elaborated and used as one of the strongest selling points in the promotion of higher education. There can be no exception to the "facts"; but with the expansion of higher education we come at last to what is sometimes technically called the point of diminishing returns, concretely illustrated by the C.C.C. army of high-school and college graduates with no place to go. To be sure, we can not blame the school people or the scientists for the present situation; but if "we" had not been so schoolmastery forty years ago we should never have permitted the statistician to convince us that by the use of scientific methods of teaching we could make every child stand at the head of the class, or attain the highest point in the nation or in the local industry. Perhaps all we can say with certainty is that a useful research instrument was applied correctly (that is according to rule) to material that the investigators did not understand.

III

Teaching rests on telling other people what it is important for them to know—or at least what it is important for some of us to have other people believe. Scientific knowledge, having shown itself more reliable than some of the older "beliefs," comes to be valued as an element in education. But since it is in the nature of science to be constantly changing, much of what is taught as scientific knowledge becomes unreliable and worthless with the passing of time. Moreover, from the nature of science, it is impossible to recognize at any given moment what present knowledge is likely to be superseded, what recent discoveries are likely to lead to further fruitful research, what present lines of thought are going to lead into blind alleys. Yet teaching continues to be preoccupied with the transmission of presumably useful knowledge.

Within the memory of some here, not the oldest even, teachers of biology had regretted that the Great Discoveries had already been made and that there remained nothing for scientists to do further but to amplify Darwin's outline—complete the collections of bugs and orchids, living and fossil, of adaptive resemblances, of "vestiges," and so on. So the progress of science consists of filling in the gaps in the technical handbook of physical and chemical properties of all the elements and all the compounds. But also, within the memory of the youngest, things taught us

have ceased to have validity or even meaning. Most of us are not greatly agitated as to whether Euglena is "really" a "plant" or an "animal," as to the exact number of "instincts" in man, as to Bohr's planetary atoms, or as to the density of the ether. Yet one perplexed science teacher asks Dr. Millikan, "Has it really been proved that the ether does not exist?"

New principles are constantly being discovered—or invented, if you prefer, since it is legitimate to think of scientific concepts as created devices. Yet most teachers can teach only what they have been taught. Even in the training of teachers the outcomes of research are imparted as standard, and therefore of universal validity and permanent. With the formulation of workable principles, with the recording and formulation of accepted or acknowledged facts, teaching tends to stress the known, to perpetuate the established. And the end results, even in many college courses, becomes indistinguishable, so far as most learners (and teachers) are concerned, from sound doctrine promulgated from other authoritative sources. The teaching process based on scientific research tends to become more effective; but the teaching product is still a crystallization of concepts. The new education in science can thus be distinguished from the old chiefly in its choice of "important" concepts and in its superior technique of imparting them. In place of lectures we use more laboratory work or demonstrations or "visual aids." In place of composition books we use more graph papers.

In the past fifteen years there has been a striking and consistent trend among educators and supervisors as well as among teachers of science to place "methods of thinking" and "scientific attitude" higher and higher among the various goals of science teaching in the high school, in contrast to the transmission of scientific "knowledge." It would seem necessary to make a wide and energetic assault upon those who are training teachers of science, to see that they teach these prospective teachers something more than the correct knowledge to transmit, something more even than standard practice in teaching "methods of science." And perhaps a similar attack may be desirable upon those already engaged in teaching science in the schools.

IV

In seeking the reason for this continued discrepancy between our proclaimed purposes and our actual performances we naturally ask whether all the scientific studies of educational problems are quite futile. Did they at least give the investigators a glimpse of whatever it is that "science" means? One obstacle to the training of science teachers, as indeed of teachers generally, appears at once in the fact that most high-school teachers have to teach two or more subjects, and that for economic and social reasons the preparation of teachers must become standardized like the training of other technicians. The specific preparation of science teachers is not generally required by conditions of certification. Preparing to teach means almost of necessity learning the minimum essentials—of content and of method—that is, acquiring a standard equipment for qualifying for a license. Since the licensing itself rests largely on examinations (or certification, which in turn rests on examination), the instruction almost unavoidably becomes in essence a passing on of things to remember.

A study by A. W. Hurd, after calling attention to some of the difficulties involved in the training of teachers for science in elementary and high schools from the point of view of suitable "professionalized" subject matter, comes to the conclusion that the most promising way of integrating the physical and organic sciences is through emphasis upon what is common to all the sciences—namely, the methods, the mode of thinking, scientific attitudes, and the social implications of science.[1]

[1] Hurd, A. W., Some Aspects of the Education of Teachers of Science in State Teachers Colleges and Normal Schools. *Educational Administration and Supervision.* January, 1934.

This appears to be sound, if our concern is with advancing the general assimilation of science rather than with the fixation of established truth. It is significant that those engaged in specialized research in one or another branch of science, or in some practical technological field, do not seem to be so generally aware of this conflict as are the students of educational problems from a broader sociological or philosophical point of view. The claims of science for popular interest and support may perhaps be measured in terms of the specific bits of "truth" revealed by research, or in the totality of such truth; certainly these findings are not to be disparaged because they are constantly being superseded by further research. But it would seem more profitable to base the claims for "science" as an element in education upon the characteristic processes of scientific analysis and scrutiny and investigation, on the supposition that suitable use of science in education would result in attitudes and skills commonly thought of as "scientific."

By way of analogy we may contrast the bearings of science upon other technological or professional departments. We can see that science has brought about revolutionary changes in engineering and sanitation, where research is applied to the solution of specific problems, as in the field of education. The engineer studies the strength of materials, for example, where the educator is concerned with individual variations; and both use standardized tests. There is need to study the speed and hardness of cutting edges, or rates and frequency of stimulus in relation to retention. The engineer studies to find best procedures for ventilation or illumination or sewage disposal or mosquito elimination. The educator investigates facilitation of the learning process, the thousand most useful words to learn, or the hundred most important capitals, or the most effective order for teaching the seven (or are there eight?) basic organic processes, as shown by "immediate and delayed retention tests with matched groups." With educators as with other technologists research yields valuable results. But there is a difference.

The engineer is called upon to show how waste of time or materials can be eliminated, how hazards can be reduced, how product can be increased. He thinks in terms of greater efficiency, but is not responsible for the social effects of the changes which he helps to bring about. Values, whether in economic terms or in broader social or humanistic terms, have to be decided by others.

The educator, on the contrary, is called upon to show that the sciences and the arts and the principles of conduct and of human relationship which are made part of the school program lead to consequences that are beneficient for the human beings who pass through the educational mill. The educator is obliged to ask, "what are the probable *human* outcomes of universal education at elementary, secondary, or collegiate level?" What is the remoter effect of introducing science in the curriculum, what is science going to do to our social relations? To such questions neither the teachers of science nor the scientific investigators of educational problems seem to be giving much thought.

V

There is a place for science in education, both in the sense that science must be made a part of the individual's education everywhere, and in the sense that educators must constantly make use of science in advancing their special professional functions. But in both senses the uniting of science with education calls for a reorientation as to the significant problems. We have been asking ourselves, as educators, "How can we most economically and most effectively transmit the findings of science, or teach whatever it is that is being taught?" These are the questions of the technician, who is concerned with doing better whatever it is that he is called upon to do.

There is now need for us to ask more directly and more insistently, "How can we

transmit the spirit of science?" or, "What does the development of science imply as to education, as to its incidence, as to its objectives, as to its methods?" These are the questions of educators who take responsibility for something more than carrying out the directions of others.

Science must be made a part of education as something more than a departmentalized addition to the curriculum, as something more than a body of attested knowledge to be learned and remembered and perhaps applied. It must become a part of education as a mode of questioning established beliefs and practices, or manifesting curiosities and giving effect to them through the constant search for significant and usable ideas, as a tradition that insists upon the use of intelligence and inquiry in the continuous adjustment of human affairs.

Dr. Robert Millikan, who is, of course, a consistent champion of science, says that "Humanity has but one supreme problem—that of kindling the torch of enlightened creative effort, and passing on for the enrichment of the lives of future generations of the truth already discovered. In a single word, the problem is *education*."[2]

Here we see in a partial parable the same confusion and conflict. Passing on the truth already discovered is precisely the procedure in traditional education to which scientists of all people must constantly take exception. If the torch of enlightened creative effort is the torch of science, it illuminates not by virtue of "truth already discovered," but by virtue of the light continuously engendered through the creative effort of restating our problems and rediscovering significant insight. The truth already discovered remains truth but a little while: and as the glowing particles cool, instead of shedding light, they form clouds of smoke to obscure the light that science can shed.

The great task is indeed education; but that must be attacked as one of kindling human beings to enlightened creative effort.

SOME TECHNIQUES IN MICROPROJECTION

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Microprojection has come to have an increasingly important place among our teaching devices in the field of science instruction. Perhaps this is particularly true with reference to the presentation of biological materials. One of the great advantages of microprojection as a teaching device is that it enables whole groups of students to observe and dicuss the same phenomena at the same time.

Living protozoa, such as paramecia, are among the more interesting subjects for such demonstrations. It is proposed here to discuss certain techniques which have been developed for the microprojection of these, and other organisms, in various types of demonstrations.

In the first place, the microprojector must, of course, be equipped with an adequate cooling device. The so-called "cooling cells" now used on some of the more modern pieces of equipment are, in the opinion of the writer, much more satisfactory than any other equipment for this purpose that is now available. Unless sufficient "cooling" of the light rays takes place, protozoa and similar types will be killed almost instantly when they are placed upon the projection stage.

It may even be found that the frequently-employed use of distilled water in the cooling cell will not provide sufficient protection from heat effects. This is likely to be the case when it is desirable to observe speci-

[2] Millikan, R. A. Science and the New Civilization. New York: Charles Scribner's Sons. p. 31.

mens over fairly long periods of time. Under such circumstances, other cooling fluids may sometimes be substituted, and may provide more acceptable results. One of these, which is commonly employed by the writer, is made up in the following manner.

Add three drops of concentrated sulphuric acid to 1000 cc., of distilled water. Then add 200 grams of ammonium ferrosulphate, and stir until this material is dissolved. Place the liquid in a battery jar (covered), and allow it to stand for forty-eight hours. A certain amount of sediment will meanwhile collect in the bottom of the battery jar. Now siphon off the clear liquid, being careful not to disturb the sediment. Filter the liquid at least three times, and keep it in a tightly-corked bottle for use as occasion demands.

For purposes of microprojection demonstrations, it is desirable to have paramecia cultures (or cultures of other protozoa) which contain a relatively large number of individuals per unit of volume. One good method of producing such a culture is as follows.

Place a quart of distilled water in an open battery jar. Add to the contents of the jar thirty-five kernels of boiled wheat, and allow the materials to stand for several days. Ordinarily, a bacterial scum will form on the surface of the water. These bacteria will serve as food for paramecia when the culture has been inoculated. Meanwhile, it is necessary to avoid having too many bacteria, as their metabolic wastes when present in too great concentration, will inhibit the successful growth and reproduction of paramecia. If and when the contents of the battery jar begin to give off an offensive odor, too many bacteria are present. Some of them must then be skimmed off the surface of the water.

The next step is the inoculation of the bacteria culture with paramecia. Place a watch crystal containing materials from an ordinary pond culture upon the stage of a compound microscope, and focus upon the materials with a low power lens. Using a pipette, pick up a dozen or more paramecia (which are usually present in pond cultures) and transfer them to the bacterial culture in the battery jar. In a few days the descendants of these paramecia will often be so numerous as to form a grayish-white "cloud" of material beneath the bacterial film upon which they feed. This is the most appropriate time to use the culture for demonstration purposes.

Although a successful culture prepared in the foregoing manner may contain an immense number of individuals, it is still possible to achieve greater concentration of individuals per unit of volume before using the material in demonstration work. This is an exceedingly simple matter. It is only necessary to take about two ounces of culture from beneath the bacterial film with the aid of a pipette, place the culture in an open dish on a desk or table, and allow some of the water to evaporate. If the dish has a broad, flat bottom, evaporation proceeds at a relatively rapid rate, and the volume of water may be decreased by one half in the course of one or two hours. This necessarily doubles the concentration of individuals per unit of volume. In turn, the chances of successful demonstrations of tropisms* and other phenomena, with the aid of the compound microscope or the microprojector, are greatly enhanced.

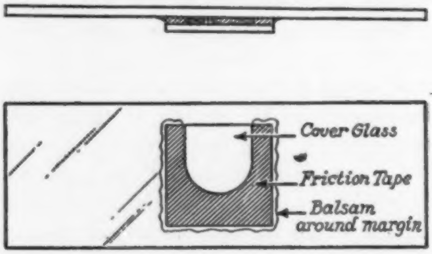
Those instructors who have experimented with microprojection in demonstrations have no doubt found that the use of a horizontal stage, with a mirror below the stage and a reversing prism above the ocular, often does not give as good illumination on the screen as will the so-called vertical-stage apparatus, which does not include a mirror or a reversing prism. On the other hand, the horizontal-stage apparatus obviates the necessity of using hanging-drop slides, or similar devices. It is only necessary to place the culture materials upon a blank slide, and place the slide upon the horizontal stage. Gravity is automatic-

* Or "trial and error" reactions, as the case may be.

ally eliminated from consideration as an essential factor. However, the attendant loss of illumination often predisposes against the most successful results in demonstrations.

The writer has avoided most of these apparent difficulties through the use of specially-prepared slides on a vertical-stage microprojector. Necessarily, the slides are the "key-factors" in solving the problem. Several of these slides may be prepared at one time. If they are kept clean by washing them each time that they are used, they will remain usable for an indefinite period of time.

The slides are prepared in the following fashion. Cut out a square of friction tape (which is of about the optimum thickness for this purpose) exactly the same size as the square cover glass which is to be used. Now cut a U-shaped piece out of one side of the square of friction tape (see figure).



The U must be considerably wider at the top than at the bottom. Coat one side of the tape with Canada balsam, and press this side down upon a blank slide. Allow the slide to stand until the balsam has hardened, and the tape is firmly cemented to the glass. Now coat the upper side of the tape with more Canada balsam, and put the square cover glass in place. Put a little Canada balsam all around the three-enclosed margins of the cover glass. After the balsam has again had opportunity to harden, the slide is ready for use.

Culture materials may be transferred to such a slide with the aid of an ordinary pipette. This is only the work of a moment, and may be done while a microprojection demonstration is in progress. If it is desired to place the culture materials in slides before a demonstration is begun, a practiceable method is to fill these special slides with culture materials, place them in a staining dish which has grooved sides (flat type), and put enough distilled water in the staining dish to fill it exactly to the upper margins of the cover glasses. Ordinarily the protozoa will not escape from the special slides, and will remain active for an adequate interval of time.

One caution should be noted in connection with the use of special slides as herein described. Culture materials used in these slides should be relatively free from the many inorganic and organic particles of material that are always present in pond cultures. This condition will be met if the method of culturing which has been described is followed. If the culture materials used contain a good many particles of extraneous material, the latter will settle to the bottom of the cavity on the special slide, soon after the slide is placed upon the vertical stage. Many protozoan types will then take refuge from the rays of bright light (to which they often react negatively) by mingling with the mass of extraneous particles. This, of course, greatly reduces the effectiveness of any demonstration.

AN INTEGRATION OF PHYSICS AND CHEMISTRY

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The general movement toward reorganization in education had its beginning during the latter part of the nineteenth century. During the past fifty years the entire field of secondary education has been undergoing a gradual process of reorganization which has been definitely related to political, economic, and social development in America.

Prior to 1890, the traditional 8–4 scheme of organization of elementary and secondary education apparently met the educational needs of the times. During that time the eight-grade elementary school was considered to be the basic school for the masses. Few of those finishing the elementary school entered high school. Economic and social conditions were such that the product of the elementary school was readily absorbed by industry. Those who entered and completed the high-school course were, almost without exception, preparing for college and for future professional careers.

In 1888 President Eliot of Harvard, in an address delivered before the Department of Superintendence of the National Education,[1] suggested a plan of reform in the field of secondary education. This plan marked the beginning of the period of reorganization and readjustment. In advocating this reform, President Eliot gave voice to a conviction that the traditional plan of education was neither meeting the needs of a growing democracy nor was it in conformity with the changing educational philosophy. The spirit of this address was evident in the reports submitted by various national committees appearing during the next twenty-five years. The trend toward reorganization and the growth of the new conception of the functions of education contributed toward the formulation, in 1918, of the seven cardinal principles of education by the committee on the Reorganization of Secondary Education.[2]

Similarly the change in our philosophy of education led to the establishment of the first junior high school in the United States, in 1909, at Berkeley, California.[3]

The junior high school of today not only represents a new plan of organization but seeks to offer new types of curricula. It attempts, furthermore, to provide a suitable educational environment for all children of approximately twelve to sixteen years of age. An analysis of the writings of authorities in the junior high school field indicates that the curriculum should be general rather than specialized.[4]

The establishment of the junior high school, and its general acceptance as the basic school of the people, was not the only consequence of the period of educational readjustment. The rapidly changing social and economic conditions of the past two decades have reacted to increase enormously the enrollment of all educational institutions—junior high schools, senior high schools, and colleges alike. As a result, not only the junior high schools but also the senior high schools and colleges have been called upon to offer educational opportunities to all. This has resulted in a changed conception of the senior high school. It is no longer regarded as strictly a preparatory school, but as the basic school of the people. It has assumed or is rapidly assuming

[1] Smith, William A. *The Junior High School.* New York, The Macmillan Company, 1926. p. 72.

[2] United States Bureau of Education. *Bulletin.* 1918; No. 35.

[3] Davis, C. O. *Junior High School Education.* New York, World Book Company, 1924. p. 18–19.

[4] Koos, Leonard V. *The Junior High School.* Chicago, Ginn and Company, 1927. p. 121.
Smith, *op. cit.* p. 266.
Davis, *op. cit.* p. 53.

the place in the educational scheme which was formerly occupied by the elementary school. Today approximately seventy per cent of the total population of the United States of ages fifteen to eighteen inclusive are enrolled in either public or private secondary schools.[5]

The changing function of the senior high school, with its accompanying reorganization of curricula, is now being reflected in the reorganization underway in numerous institutions of higher education, for example; Chicago, John Hopkins, and Stanford Univeristies.[6] On the other hand, in a considerable number of instances, high schools have extended their programs of curricula offerings to include courses on a post graduate level. These courses are comparable, in most cases, to those offered during the first two years of college.

These conditions contributed to the establishment of the first permanent junior college at Joliet, Illinois, in 1902.[7] The junior college movement has spread rapidly in the United States until at the present time there are 533 institutions.[8] Like the junior high school, the junior college has as one of its major functions the providing of educational opportunities for all.[9]

This reorganization of secondary education has created a demand for a distinctly new type of curriculum. The idea of providing a general education for all has replaced the older idea of preparing a few for college or university work. Preparation for life has come to be one of the major aims of the secondary school. The shifting of emphasis from the teaching of subject matter to the teaching of boys and girls has in many instances caused courses to be organized, not in terms of the logical divisions of a specific subject but in terms of some phase of life interest of the pupil or some phase of a general field of knowledge. Such courses frequently have no regard for departmental boundaries but cut horizontally across the subject matter barriers and include phases of several subjects hitherto regarded as entirely separate. Such courses constitute so-called integrated courses.

The field of natural science lends itself readily to integration, as is shown by the fact that two such integrated courses are now firmly established in our secondary schools. The general science movement originated soon after the beginning of the twentieth century, the first course being established about 1905. This movement represented the first attempt to overcome the tendency to offer too highly specialized subjects in the secondary schools. By the period of 1915 to 1920 many schools had introduced this course.[10] In 1934–35, approximately eighty per cent of the high schools in Nebraska offered general science.[11]

Previous to the report of the Committee of Ten (1893) it was common practice for high schools to offer one semester courses in each of the sciences, physics, chemistry, botany, and zoology. The report of the Committee, however, recommended that each science should extend throughout a school year. This resulted in the stressing of two-semester courses in both chemistry and physics. Although botany held its own quite generally as a half-year course, zoology on the other hand was practically eliminated except in larger schools. This situation prevailed until the Committee on College Entrance Requirements (1899) recommended for the second year of high school, "biology, botany or zoology, or botany and zoology."[12] Following this

[5] Koos, Leonard V. "Educational News and Editorial Comment." *The School Review* 43: 241–257; April, 1935.

[6] Eells, Walter Crosby. *The Junior College.* Chicago, Houghton Mifflin Company, 1931. p. 47–52.

[7] Eells, *ibid.*, p. 54.

[8] Campbell, Dock S. "Directory of Junior Colleges, 1935." *Junior College Journal;* January, 1935.

[9] Eells, *op. cit.*, p. 656.

[10] Clement, John Addison. *Curriculum Making in Secondary Schools.* New York, Henry Holt and Company. p. 329.

[11] Johnson, Grace Martin. Unpublished Masters Thesis, University of Nebraska, 1935.

[12] Twiss, G. R. *Science Teaching.* New York, Macmillan, 1917. p. 193.

recommendation, one or another of the four kinds of courses were usually found in the first or second year of high school.

The offering of a year of biology stimulated the publication of text-books in which the content was so arranged that half a year was given to botany and half a year to zoology. At first little or no attempt was made to organize the materials about life processes common to both plants and animals. Gradually, however, authors of texts began to correlate the two divisions, to seek to develop the understanding of basic principles, and to minimize the inclusion of isolated facts. This effort was accompanied by a decrease in the number of separate botany and zoology courses and a corresponding increase in the number of biology courses. Today biology occupies a prominent place among high school sciences. In 1934–35 approximately seventy-two per cent of Nebraska high schools offered biology.[13]

The same forces which brought about the establishment of general science in the junior high school and of general biology in the first year of the senior high school are now contributing toward the establishment of similar courses at a junior college level. Such courses are usually designated as survey or general courses. The need for general courses on a junior college level is evidenced by the fact that many colleges have already introduced or are developing such courses in the natural sciences. The consensus of opinion seems to be that these courses will better meet the needs of those students who desire a brief acquaintanceship with science but who have their major interest elsewhere. In other words, they are being organized with a view to meeting the needs of a general education.

That point in the educational ladder at which general education should end and specialization should begin appears to be very much in dispute. However, present tendencies seem to indicate that general education should at least extend throughout the senior high school years and in all probability should include at least one and possibly two years at the junior college level. Today general science and biology are firmly intrenched in our high schools and there is evidence to indicate that integrated physical science courses as well as biological science courses are rapidly gaining ground in the junior college years. Little has been done, however, looking to the integration of the specialized physics and chemistry courses at the senior high school level. There is no sufficient reason to believe that education in the physical sciences should be general in junior high school and junior college and remain specialized in the senior high school.

That an integration of those specialized courses is highly desirable as a part of the reorganization program is given definite expression in the following quotations:

> The present partition of the sciences is the accidental result of their historical development like the prevailing boundaries of nations. A generalizing and synthesizing course of a more elementary character seems to be needed in the high school.[14]
>
> The whole matter of departmental hostility appears inexcusable and ridiculous in view of the fact that the only divisions of knowledge which we have were set up by the human mind. We have become aware that problems in life are not solved by courses, but by our just knowledges, our integrated experiences. Probably what we need as much as anything is to help our students to see the relation of ideas, and thus of subject matters.[15]
>
> Teachers and taught need to be reminded, time and again, that the only divisions in the rational world are divisions which were imposed by the human mind and merely as convenient devices, different ways of viewing and comprehending a genuinely corporate whole.[16]
>
> Probably one of the greatest hindrances to the fusion and integration of the content of various high school courses is the barrier set up by departmental organization . . . Very little actual work has been done in the secondary field.[17]

[13] Johnson, *op. cit.*

[14] Slosson, Edwin E. "The Philosophy of General Science." *School Science and Mathematics* 25: 9–20; January, 1935.

[15] Freden, Gustaf. "The Course as a Unit of Teaching." *School and Society* 40: 773–775; December 8, 1934.

[16] Sibley, R. P. "Orientation Courses." *School and Society* 40: 373–377; September 22, 1934.

[17] Cummings, Frank L. "Practice of Fusion of Subject Matter in Various Courses." *California Journal of Secondary Education;* October, 1934.

> Little has been done as yet to revamp the senior high school science so as to make it correlate with the newer approach in the junior high school. This task lies largely ahead and should also be frankly faced for the sake of the pupil. Neither in common life nor in research is the artificial stratification of the sciences maintained in solving problems.[18]

> The present differentiation of high school science into a large number of special sciences, physics, chemistry, biology, domestic science, etc. is seriously questioned. Fundamental and thoroughgoing experimentation to develop new and broader groupings of subject matter which will cut across the present differentiated sciences is greatly needed and should be definitely undertaken whenever possible.[19]

With a view to projecting further into the senior high school curriculum the idea of a more generalized science teaching, there has been developed at the Teachers College, University of Nebraska, during the past year, a course which represents an integration of certain selected portions of the traditional physics and chemistry courses. The selection and organization of the subject matter of this course was undertaken by the author during the school year 1934–35. The work was done under the direction of Dr. G. W. Rosenlof, Professor of Secondary Education, and Dr. P. G. Johnson, Assistant Professor of Secondary Education.

The course follows the Morrison unit plan and, in accordance with Morrison's recommendation for senior high school science,[20] has been organized into units which are significant aspects of science rather than significant aspects of the environment. It is felt that a knowledge of such aspects of the environment should be considered as applications of the general understandings of physical science and not as basic criteria for organization.

The course as tentatively organized does not purport to cover the entire fields of chemistry and physics to the extent that they are covered by the specialized subjects now being offered in the senior high school. It seeks rather to develop a basic one-year course in physical science which may later be used as a foundation for a second-year course of a similar nature.

In perfecting the unit organization, four distinct steps were involved. First there was set up a list of major generalizations from the fields of physics and another list from the field of chemistry. The generalizations in each case were representative of the fundamental topics of the traditional courses in each field.

The next step was to combine or integrate those major generalizations of the separate fields into a single list representing the major generalizations of a physical science field. This was accomplished by means of setting up a list of broader generalizations each of which included one or more of the major generalizations from each of the specialized fields. The result was a list of ten major generalizations which was to serve as the nucleus of the integrated physical science course. These, when stated in problem form, become the unit problems about which the subject matter was organized. The problems are as follows:

1. What is matter and how is it affected by chemical and physical forces?
2. How do fluids respond when chemical and physical forces are made to act on them?
3. How do scientists represent chemical and physical changes?
4. What is heat, and how does heat contribute to physical and chemical changes?
5. What are acids, bases, and salts, and how do they behave in solution?
6. What is the nature of metals, and how are metals used in doing work?
7. How may electricity be produced, and what are the physical and chemical effects of an electric current?
8. What is the physical and chemical nature of non-metals?
9. What is the nature of light, and how is light affected by the media which it encounters?
10. What is the nature of sound, and what are the effects of sound energy?

[18] Commission on the Reorganization of Secondary Education, United States Bureau of Education. *Bulletin* 1920; No. 26.

[19] Osborne, Raymond W. "Report of Group Conference on Modernizing our Secondary School Science." *School Science and Mathematics* 31: 608–609; May, 1931.

[20] Morrison, Henry C. *The Practice of Teaching in the Secondary School.* Chicago, The University of Chicago Press, 1926. p. 173.

The third step, that of analyzing each unit problem, involved breaking each major problem up into more specific sub-problems which in turn were, in many cases, again subdivided into still more specific problems. The division was on the basis of more specific understandings which contributed to a broader understanding. This process of analysis resulted in a different type of subdivision for practically each one of the ten unit problems, since the type of sub-division depended upon the nature and complexity of the original problem. The division was continued in each instance until the final sub-divisions represented phases of the unit problem, a mastery of which would require about two to four days of classroom study. These specific problems thus became the teaching problems.

The fourth step consisted of the further analysis of each teaching problem to indicate related ideas. This involved the selection and organization about each teaching problem of portions from the subject matter of physics and chemistry which would, through their classroom development, enable the pupil to arrive at a generalization or major understanding constituting the answer to the teaching problem.

It is felt that the ultimate organization of the physical science course will require time, patience, and additional research. The organization of material which has been perfected is in no sense considered final. However, it was obvious that there must be an organization of subject matter before specific plans for teaching could be perfected and before the actual experimental teaching of the course could be started.

The integrated course is being tried out in the classrooms of the Teachers College High School during the present school year, 1935–36. Eighteen students who in every way represent a cross section of the total high-school enrollment are registered in the new course. The class is in charge of a student teacher who has had adequate preparation in both physics and chemistry and in methods of teaching physical science subjects. Several different plans of teaching are to be followed during the year.

It is expected that the reactions of this experimental group will bring to light many needed revisions of the original organization. However, it is hoped that, through continued experimental testing followed by revision, the course may gradually emerge from the experimental stage. The development of a testing program which would adequately measure the educational outcomes of the course in terms not only of factual knowledge but of understandings, skills, attitudes, and appreciations would likewise be highly desirable. In this way it may be possible eventually to arrive at an objective comparison of the outcomes of the integrated course with the outcomes of the specialized courses and thus to draw an accurate conclusion as to its effectiveness as one of the factors in a general education.

THE PLANT-ANIMAL COMMUNITY*

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As we go back in the history of the teaching of biology, we find that the study of animals and plants was first introduced into our public schools for the purpose of showing the students the ubiquitous love of God. From such pious beginning, the teaching objective slowly developed into an appreciation of Nature, with special emphasis on the extraordinary and bizarre forms of life. A minute study of these unusual animals and plants produced a keen interest in anatomy, and then biology became the accumulation of details and detached facts. At about this stage, the Darwinian theory of evolution began to be accepted and it was avidly seized upon as the fundamental philosophy of biology. It is interesting to notice, however, that the original facts of evolution, as put forth by Darwin, were soon forgotten, and most Americans were taught the German interpretation of evolution. We studied ameba, hydra, and the earthworm; recited the magic formula: "*Monera, blastea,* and *gastrea*"; and we knew all there was to know about zoology. Or we studied spirogyra, oedogonium, and the moss; parroted: "isogametes, heterogametes, gametophyte and sporophyte"; and we knew all about botany. While we still talk about evolution, it can no longer be accepted as the keystone of biological education. We must develop a new philosophy if our science is to meet the needs of our students.

While biology has been passing through this evolution, the curriculum of our schools has changed. At the present time there are three major subjects in the curriculum of the modern high school: English, social science, and natural science. The English is the primal tool that allows the student the opportunity to become a social being. The social sciences form the background for the behavior of the social being. And the natural sciences familiarize the social being with the laws that determine his place in a social world. Today, the entire educational set-up has for its aim, the creation of a social individual. If biology is to fit into this scheme, it must be based on a sociological philosophy. And as a stepping stone to such a sociological biology, the plant-animal community serves admirably.

Did you ever stop to wonder why plants and animals live where they do live? Why do you live where you do? You live in a certain place because you behave in a certain manner. You have a definite behavior pattern that gives you a job and allows you to make your living. But the possession of a behavior pattern is not the only reason for your living in a certain place. The behavior pattern which you assume must be acceptable to the other members of the community in which you live. In carrying out this behavior pattern, you must function as a part of the community.

For precisely the same reasons, animals and plants take up a definite abode. Each animal and plant has a greater fixed behavior pattern which determines how it will react. It must live, and as it lives it exhibits a certain behavior. In expressing this behavior pattern the animal or plant affects the other members of the community in which it lives. The deer, as it browses on the trees and shrubs of the forest, is merely living, but it is also affecting the trees and the shrubs. The pine tree, as it drops its senile needles to the ground, is merely living, but it is excluding the grasses and herbs which might grow in its shade. In other words, the living animal or plant produces changes in the habitat in which it lives. The only animals and plants which are able to live in the same community, are those which

* A digest of an address before the Science Section, Eastern Division of the N. Y. State Teachers Association, October, 1935.

can either withstand or benefit by the changes that are produced. The community, as a whole, accepts the behavior pattern of the animal or plant, just as the community in which you live, accepts your behavior pattern.

Not only are plant-animal communities the same in their fundamental make-up as human communities, but they operate under the same sociological ideas as do human communites. It is impossible for me to go into detail on this point, but let me illustrate by mentioning only three of these ideas.

1. *The Idea of Dominance.* In every community there is one group of individuals that dominates the entire community. In an agricultural community the farmers are the dominant members. If you live in an agricultural community you live a certain type of life because you accept the standards that are laid down by the farmers. In an industrial community the workers are the dominants. They determine the type of clothes you wear, the kinds of movies you see, and the plan of local government under which you live. The life in a city is entirely different from the life in the country, not because the people are biologically different, but because the community is dominated by different groups.

Each plant-animal community is dominated by some one group. In a forest, the trees completely dominate the community. They determine, to a large extent, what other plants and animals can come into the community. A plant which cannot withstand the shade and moisture of the forest, cannot live under the dominance of the trees. In some of our lakes and sluggish rivers, the carp may dominate the entire community. As these fish go about their business of finding food and mating, they so stir up the mud from the bottom of the pond that the sunlight is unable to penetrate the water, and there is no light for the green plants. As the green plants die, the plankton organisms are robbed of their food, and as the plankton disappears the predaceous fishes cannot find food, therefore they are excluded from the community.

2. *The Idea of Balance in Industries.* Everyone realizes that in human communities there must be a nice balance of industries. But we do not fully appreciate this balance until it is disturbed. During prosperous times, there are some farmers who grow cotton, some grow tobacco, and some grow potatoes. As long as we all have enough, and not too much, we do not worry about who grows what. But in recent times, there has been a surplus of cotton. The cotton farmer was instructed not to grow so much cotton; he planted tobacco instead. Soon there was a surplus of tobacco, and he was told not to grow tobacco. Then he planted potatoes, and now there are too many potatoes. Whenever man attempts to control this balance, he gets into trouble.

The most notorious disturbance of the balance of industries in Nature is seen in the West Indies. As ships began to call at the islands, they brought along some Norwegian rats. These rats had no competitors on the islands, and found them an ideal place to multiply. Soon they were destroying the native fauna and crops. Someone had the bright idea of importing the mongoose, a noted ratter. It is true that the rats have now disappeared, but at the present time the mongoose is a greater pest than the rats ever were. In our own country, when the white man came to America, the first thing he did was to kill most of the carnivores: wolves, coyotes, and mountain lions. As soon as he reduced the number of carnivores the herbivores became plentiful. Slowly many of the herbivores are being extirpated. With the destruction of the herbivores, the insects have increased until now the government spends millions of dollars a year to control them. These animals would never have become pests if the fine balance of Nature had not been disturbed.

3. *The Idea of Development.* If we trace the history of any human community, we shall find that the first people to settle there

were pioneers. As the community grew, the pioneers were not able to live as freely as they desired, and they were forced to move on. The community changed from a frontier outpost to a town as each successive group moved in and dominated it. Plant-animal communities develop by a similar succession of occupants. On the sand plains of the Capitol District (New York), the pioneer grass that holds the sand in place, is crowded out by the poplar trees and the scrub pines. The pines and poplars give way to the oaks, and the oaks in turn give way to the maples.

As these plant-animal communities are studied, we find that all the laws that are applicable to any social community are operating. The law of supply and demand is just as potent in natural communities as in human communities. The law of diminishing returns is just as true in biology as in business.

Obviously, in order to adequately study these communities we must take our students out into the woods and fields. If you are not already taking field trips, you are missing half the fun of teaching biology. We must augment our laboratory studies with observations under natural conditions, if we are to make biology a practical part of the educational system. Biology will teach itself if we will but introduce our students to the living plant and the living animal. And from the appreciation of the dynamic social life of animals and plants, the student will be better able to comprehend the intersections of the community functions in human society.

QUESTIONNAIRE STUDY OF STUDENT EXPECTANCY FROM A COURSE IN GENERAL CHEMISTRY

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The following questionnaire study was made to find what knowledge a student beginning general chemistry expected to find behind its mystic portals and the purpose for his taking the course. The questionnaire was given during the first month of the school year to all students in the city of Mitchell, South Dakota, who are now studying general chemistry. The total number contacted was 112. This number included 39 college freshmen and sophomores, 24 having studied chemistry in high school, and 15 studying chemistry for the first time in their college course, and the remaining 73 were starting the study of chemistry in high school. The questionnaire used was as follows:

You are asked to list your first, second and third choice as to what knowledge you expect to get from this course in chemistry. You may select the following suggestions or write in other reasons of your own choosing.

1. Knowledge of drugs and their uses
2. Mechanical knowledge such as use and understanding of oils, combustion, *etcetera*
3. Knowledge and skill in analysis, that is, finding what a substance contains
4. Cultural values, enlarged vocabulary, appreciation of your chemical surroundings
5. Household helps as knowledge of baking powder, use of cream of tartar, *etcetera*
6. Production of new substances
7. Processes involved in the making of food products
8. Separation of typical mixtures, such as ores or gasoline from crude oil
9. Processes involved in making commercial products such as inks, cosmetics, iron, *etcetera*
10. A science credit
11. Mathematical knowledge and how to handle problems
12. Hobby
13. Preparational subject for a major course

(Add any other items)

The information gained from this study has been arranged in Tables I and II and shown as a graph in Figure 1. A comparison in each case with the question number in the original questionnaire will indicate the reason for the study of chemistry that is implied. The replies have been

TABLE I

Tabulated Results of Thirteen Questions by all Chemistry Students

Question Number	College Students with High-School Chemistry			College Students with No High-School Chemistry			High-School Chemistry Students			Total for All High-School and College Students			Total Rank of All Replies			Final Rank Based on All 1st, 2nd, and 3rd Choices	
	1st Choice	2nd Choice	3rd Choice	1st Choice	2nd Choice	3rd Choice	1st Choice	2nd Choice	3rd Choice	1st Choice	2nd Choice	3rd Choice	1st Choice	2nd Choice	3rd Choice	Total	Rank
1	5	0	1	1	0	0	3	5	2	9	5	3	4	7	9*	17	7
2	2	5	2	2	1	1	8	7	5	12	13	8	3	3	5	33	3*
3	7	2	2	2	3	2	13	14	8	22	19	12	2	1	3*	53	1
4	2	5	6	0	3	1	3	9	4	5	17	11	5*	2	4	33	3*
5	0	0	1	0	0	2	2	3	1	2	3	4	8*	9	8*	9	11*
6	1	0	1	0	1	2	2	5	11	3	6	14	7*	6*	2	23	5
7	1	2	1	0	2	0	0	0	3	1	4	4	9*	8*	8*	9	11*
8	1	3	0	0	1	0	0	3	6	1	7	6	9*	5*	6*	14	8
9	0	1	1	1	0	1	1	6	1	2	7	3	8*	5*	9*	12	10
10	0	2	5	0	1	3	5	5	11	5	8	19	5*	4	1	32	4
11	0	3	3	1	1	0	2	2	9	3	6	12	7*	6*	3*	21	6
12	0	0	0	0	0	2	4	4	3	4	4	5	6	8*	7	13	9
13	0	0	0	6	2	0	22	4	6	28	6	6	1	6*	6*	40	2

* Tied for place.

tabulated as the first, second and third choice in each case and then the final totals from these values. The replies have also been grouped into three sections: one section for those college freshmen and sophomores who had previously studied chemistry in high school, another section for those college students who were studying chemistry for the first time; and finally those students who were just starting their study of chemistry in high school. For example, 53 students from the three groups indicated that question number 3, (knowledge and skill in analysis, that is finding what a substance contains) was an important item, placing it first, second or third, as their reason for selecting this course in chemistry as a part of their scholastic program. This information is contained in Table I.

In Table II an attempt has been made to arrive at a final evaluation and summation of all the replies. A first choice has been assigned 3 points, a second choice 2 points, and a third choice 1 point. These totals then provide a slightly different order of importance than those included in Table I where all replies are given equal evaluation.

This information is more completely and logically arranged in Figure 1. In this figure the totals for all students for first, second, and third choices, as well as the grand total and totals based on the point systems, are included.

The number of students questioned in every case will not correspond with the total number of replies because many times the reasons given could not be recorded or were remote from the subject. Many of the replies were reasons for taking chemistry rather than the knowledge they expected to get from a chemistry course. Examples of these are: (1) Liked "lab" work; (2) Because my folks want me to; (3) Liked the teacher; (4) Needed the credit; (5) Thinking of going into beauty work; (6) Took it so I wouldn't have to take home economics or bookkeeping; (7) Because I like scientific subjects; (8) Nothing else interesting to take; (9) I don't know why. Others were even more remote such as: (1) I like to learn of the unknown; (2) Interested in chemistry; (3) To learn

about various things in chemistry; (4) Because it was recommended.

TABLE II
TABULATED RESULTS USING POINT SYSTEM FOR EVALUATION
1st choice, 3 points; 2nd, 2 points; 3rd, 1 point

Number of Question	*Total Points*	*Rank*
1	36	6
2	70	3
3	94	2
4	49	5
5	14	12
6	35	7
7	15	11
8	23	10*
9	23	10*
10	50	4
11	33	8
12	25	9
13	105	1

* Tied for place.

CONCLUSIONS

1. As a general rule the knowledge expected to be gained by a high-school student and a college student are the same. The exception is that more high-school students are taking chemistry for science credit.

2. A large number of students are taking chemistry as a basic foundation for some other course or vocation.

3. Another large portion are expecting to get some skill in qualitative analysis.

4. A surprisingly large number of boys, both high-school and college, were studying chemistry for the cultural values, enlarging vocabulary, appreciation of chemical surroundings, *etcetera.*

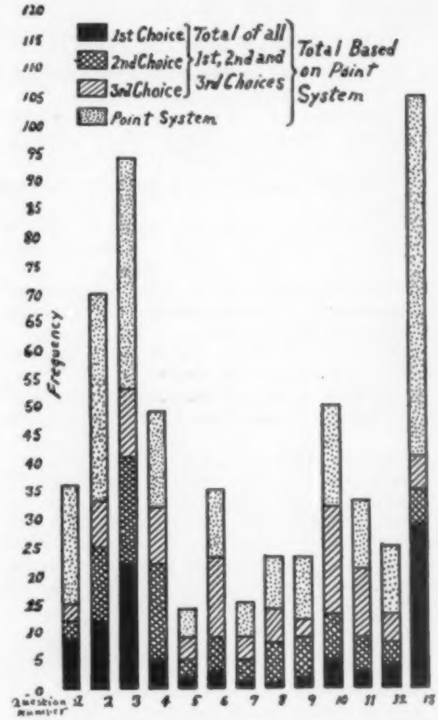

FIGURE 1.—Prevalence of Thirteen Reasons Why Students Elect Chemistry.

5. Girls seem to be the only ones interested in household helps or the processes of food products.

ELEMENTARY SCHOOL SCIENCE REFERENCES AND INSTRUCTIONAL MATERIALS*

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BIBLIOGRAPHY NO. 1. SCIENCE REFERENCE MATERIALS FOR CHILDREN

5. Experiments to Perform

Benedict, Francis Gano. *Chemical Lecture Experiments.* The Macmillan Co., 60 Fifth Ave., New York. 1925.

This is an excellent collection of classified chemical experiments for elementary use. Some can be done by the children and others more appropriate for teacher use. Grades 7–12. $1.80.

Collins, A. Frederick. *Boys' Book of Experiments.* Thomas Y. Crowell Company, 393 Fourth Ave., New York. 1927.

This book will be of interest to adults as well as children. It carries one forward in several fields of science by means of simple experiments. It is classified at every step by diagrams and working outlines. Grades 6–9. $2.00.

Collins, A. Frederick. *Experimental Chemistry.* D. Appleton & Co., 35 West 32nd St., New York. 1930.

This is full of simple and spectacular experiments that may be done by children with simple apparatus. The directions and illustrations are simple and complete. $2.00.

Collins, A. Frederick. *Experimental Science.* D. Appleton and Company, 35 West 32nd St., New York. 1929.

This book contains a wide range of physical and chemical experiments designed for both information and entertainment. How to make carbon-dioxide, making a fire with an ice lens, are typical ones. Grades 4–9. $2.00.

Collins, A. Frederick. *Magic of Science.* Fleming H. Revell and Co., 158 Fifth Avenue, New York. 1917.

This contains many interesting and simple experiments that can be done by fifth and sixth grades with simple apparatus. Many of these will furnish amusement and entertainment. Grades 5–6. $1.50.

Collins, A. Frederick. *The Boy Chemist.* Lothrop, Lee & Shepard Co., 126 Newbury St., Boston, Mass. 1924.

An exhaustive body of simple but interesting experiments from all phases of the chemical environment for boys and girls to do. The directions are clear enough with illustrations, where necessary, to enable children of fifth and sixth grades to do many of them without teacher supervision. $1.20.

Darrow, Floyd L. *The Boys Own Book of Science.* The Macmillan Co., 60 Fifth Ave., New York.

This book contains a rich collection of experiments of both chemical and physical nature for boys and girls. It describes the apparatus and gives direction for the experiments. It includes also twelve biographical sketches of noted scientists. Grades 6–9. $2.00.

DeRatti, Aurel. *Simple Experiments in Static Electricity.* The Model Engineer Series. Distributed by Spon and Chamberlain, 123 Liberty St., New York. 1925.

A number of novel experiments many of which can be done with simple equipment. Well illustrated. $0.25.

DeRatti, Aurel. *Simple Science Experiments.* The Model Engineer Series No. 15. Distributed by Spon and Chamberlain, 123 Liberty St., New York. 1925.

Forty-six entertianing and instructive experiments and how to perform them with simple home-made apparatus. Fully illustrated. $0.25.

Frank, J. O. *Mystery Experiments and Problems for Science Classes and Science Clubs.* J. O. Frank and Sons, Oshkosh, Wisconsin. 1933.

This book contains an extensive collection of novel and exciting experiments that have been collected from many sources and contributed by many teachers. Grades 6–12. $2.25.

Gibson, C. R. *Scientific Amusements and Experiments.* J. B. Lippincott Co., 1249 S. Wabash Ave., Chicago, Ill. 1926.

This contains more than two hundred fascinating tricks and experiments with careful directions. They will be especially interesting for club activity. $2.00.

Gibson, Charles Robert. *Electrical Amusement Experiments.* Seeley, Service & Co., London. 1925.

This book is more than the title would suggest. It is filled with suggestions and directions for experiments and electrical construction. Such

* (Continued from December, 1935, issue).

items as: Hand of Mystery Answers Questions, A Floating Battery, How to Build a Microphone, indicate the type of project. Grades 4–9. $2.50.

GIBSON, C. R. *Scientific Amusement Series.* Seeley, Service & Co., London. 1926.
This contains many experiments for both amusement and instruction such as spinning iron wheel by magnetic candle flame, electric soap bubbles, experiments and stunts with frictional electricity. Grades 4–9. $2.50.

GILBERT, A. C. *Gilbert Chemical Magic.* A. C. Gilbert Co., New Haven, Conn. 1920.
A collection of chemical tricks and experiments that will interest young people and stimulate interest for club and class room. $1.00.

GILBERT, A. C. *Light Experiments.* A. C. Gilbert Co., New Haven, Conn.
This offers a large number of simple experiments in light, color, and all kinds of simple optical instruments with their directions for their construction. Experiments with mirrors, mixing colors, optical illusions and construction of periscopes, telescopes and kaleidoscopes, illustrate the kind of projects. Grades 4–9. $0.75.

GILBERT, A. C. *Sound Experiments.* A. C. Gilbert Co., New Haven, Conn.
This is a small book filled with simple but fundamental experiments on sound phenomena, such as, How to Produce Beats, Sound Interference, Sound Waves, Making a Sound Lens, Musical Flames, Breaking a Glass with Your Voice, Grades 4–9. $0.75.

GOOD, ARTHUR. *Magical Experiments.* Walter V. McKee. 1892.
This book is a storehouse of fun and interest for the young person. How to Make a Lamp Chimney Smoke a Cigarette, Break a String on the Inside of a Bottle, and Automatic Candle Extinguisher, are some of the titles. Grades 4–9. $1.50.

GORDON, BERTHA F. *Prove It Yourself.* F. A. Owen Publishing Co., Dansville, N. Y. 1929.
An elementary science book, explaining how the teacher or pupils can make simple experiments to prove various principles. No special equipment necessary. 88 illustrations. $1.50.

JOHNSON, VALENTINE E. *Chemistry and Chemical Magic.* George H. Doran Company, 38 West 32nd St., New York. 1912.
This contains many experiments, some of a practical nature and others to amuse and mystify. It is of interest to the upper grades. $1.00.

KEELOR, KATHARINE L. *Working with Electrcity.* The Macmillan Company, 60 Fifth Ave., New York. 1929.
This book suggests simple and interesting experiments in practical electricity. Directions are clear and diagrams good. It deals with lights, bells, magnets and messages. Grades 3–5. $1.75.

LIPPY, JOHN D. *Chemical Magic.* George Sully & Co., 114 East 25th St., New York. 1930.
Chemistry is presented here for amusement and pastime. Many of the experiments are either spectacular or mystifying in nature. Directions are simple. Illustrated. $2.00.

MCKAY, HERBERT. *Easy Experiments in Elementary Science.* Oxford University Press, 114 Fifth Ave., New York. 1929.
A practical book presenting directions for simple experiments which may be performed in the classroom and which do not call for special apparatus. Grades 6–9. $0.50.

NEWTH, G. S. *Chemical Lecture Experiments.* Longmans, Green and Company, 55 Fifth Ave., New York. 1922.
This is a splendid list of experiments for the elementary level, many of which may be done by the children and others more effectively done by the teacher. Grades 7–12. $1.60.

SEAVER, CHARLES HOMER. *American Boy's Book of Electricity.* Walter V. McKee, Inc. 1916.
This book contains directions for many practical uses and applications of electricity, such as making bells, buzzers, batteries, dynamos, toasters, and many wiring operations and stunts. Grades 4–9. $2.00.

SMITH, E. L. *Everyday Science Projects.* Houghton Mifflin Co., 2 Park St., Boston, Mass. 1919.
This is a book of fundamental experiments and simple projects in physical and chemical and biological sciences that children can do. Making Heat by Friction, Experiments with Pendulums, Experiments with Ventilation, Ways of Making Secret Ink, How to Make Soap, and How to Pasteurize Milk, illustrate the nature of the projects. Grades 4–6. $0.96.

WILLIAMS, ARCHIBALD. *Thinking It Out.* Thomas Nelson and Sons, 381 Fourth Avenue, New York. 1935.
The book is devoted to investigating in a simple manner some of the common physical principles as they are met in the things of everyday life. The extreme simplicity and clarity of the language and the clever devices used to lead one into a situation where he wants to think his way out are unequaled. It is interesting for adults as well as young boys and girls. $1.70.

YATES, R. F. *Boys' Playbook of Chemistry.* The Century Co., 353 Fourth Ave., New York. 1923.
Construction of equipment for home laboratory and experiments arranged progressively. $1.60.

6. THINGS TO DO

Acker, Ethel F. *400 Games.* F. A. Owen Publishing Co., Dansville, N. Y. 1923.

Here are games for every occasion in which children would be concerned. It includes games for school, the home, at camp, for all the seasons, rainy days and other occasions. All grades. $1.50.

Adams, Morrill. *Rude Rural Rhymes.* The Macmillan Co., 60 Fifth Ave., New York.

The homely rhymes are terse, pithy and humorous and show a keen perception of the rural scheme of life. They run up and down the scale from evolution and the Bible to hair tonic, diet and plumbing. $2.00.

American Radio Relay League. *Hints and Kinks for the Radio Amateur.* The American Radio Relay League, West Hartford, Conn. 1933.

This book is full of information and practical tips that amateurs all over the world have evolved to meet every conceivable need. It contains chapters on work shop ideas, receivers, transmitters, power supply and so forth. Grade 6 up. $0.50.

American Radio Relay League. *The Radio Amateur's Hand Book.* The American Radio Relay League, Inc., West Hartford, Conn. 1935.

This furnishes a wealth of information for the amateur. It covers short wave transmission and explains the assembling of equipment, the qualifications for and method of obtaining of license. $1.00.

American Radio Relay League. *The Radio Amateur's License Manual.* The American Radio Relay League, West Hartford, Conn. 1934.

This contains the necessary information on every phase of the amateur licensing procedure. It explains where to apply and how to go about preparing for the examination. Nearly 200 licensing examination questions with answers are included. Grades 6 up. $0.25.

Bailey, L. H. *The Nursery Manual.* The Macmillan Co., 60 Fifth Ave., New York. 1920.

A standard reference and guide on the propagation of plants. The first section describes and demonstrates the various ways of multiplying plants by seeds, layers, cuttings, buds, grafts and otherwise. The second section contains an extended alphabetical list of about 1,500 plants with full indications of the best method of propagation. $2.50.

Bailey, L. H. *The Pruning Manual.* The Macmillan Co., 60 Fifth Ave., New York. 1916.

This book gives clear instructions for pruning trees and shrubs from infancy to maturity, training of vines and shrubs and valuable information on other plants. The illustrations show how to follow instructions. $2.50.

Blackstone, Harry. *Secrets of Magic.* George Sully & Co., 114 East 25th St., New York. 1929.

This is a book of magic for the beginner and the amateur. It describes the methods and techniques of the magician and gives explicit directions for many clever and mystifying tricks. $2.00.

Bullivant, Cecil H. *Every Boy's Book of Hobbies.* Thomas Nelson & Sons, 381 Fourth Ave., New York. 1912.

This book contains suggestions and directions for many things to do. It includes activities for the workshop, Indoor Hobbies, Outdoor Hobbies, collecting activities and many other features that will interest boys. Grades 6–9. $2.00.

Canfield, Mrs. D. F. *What Shall We Do Now?* Frederick A. Stokes Co., 443 Fourth Ave., New York. 1907.

A popular treasury of games, amusements and occupations for home, school, rainy days and outdoors, individuals or parties. A new section has been added of games especially suitable for all the special holidays. $2.50.

Carpenter, Warwick S. *Winter Camping.* The Macmillan Co., 60 Fifth Ave., New York. 1920.

This book written by one of much experience discusses the necessity outfit, food, packing, transportation, shelter, beds, campfires, stoves, snowshoes and skis. $1.00.

Duff, James. *Bows and Arrows.* The Macmillan Co., 60 Fifth Ave., New York. 1927.

The book by one of forty years' experience tells how you can make your own archery equipment. It tells of the different woods suitable, how the woods should be cut and seasoned, what parts and kinds to use, how the bows are cut out, worked down and finished, how the bowstrings are fitted and the arrows made and tipped and feathered, how to shoot and how to make a target and conduct a tournament. $2.00.

Fraser, Chelsea. *The Boy Busy Book.* Thomas Y. Crowell Company, 393 Fourth Ave., New York. 1927.

This is a practical book of home repairs. It gives directions for the care of tools and their use in making many useful things for the kitchen and home generally. Grades 6–9. $2.50.

Gilbert, A. C. *Glass Blowing.* A. S. Gilbert Co., New Haven, Conn

This book gives directions for making a large variety of things out of glass as well as specific

directions for the simple techniques of glass blowing Some of them are cutting, bending and annealing glass and making such as alcohol lamps, fire extinguishers and so forth. Grades 4–9. $0.75.

GILBERT, A. C. *Hydraulic and Pneumatic Engineering.* A. C. Gilbert Co., New Haven, Conn.
The title sounds rather grown up but the book is for children. It is crammed with simple experiments and directions for construction on all phases of the mechanics of air and water, such as: fountains, pumps, siphons, sand blasts, submarines and caissons. Grades 4–9. $0.75.

JONES, S. I. *Mathematical Nuts.* S. I. Jones, Publisher, Life and Casualty Building, Nashville, Tenn. 1931.
An interesting collection of 700 stimulating problems of a challenging nature. $3.50.

JONES, S. I. *Mathematical Wrinkles.* S. I. Jones, Publisher, Life and Casualty Building, Nashville, Tenn. 1931.
A collection of novel, amusing and instructive mathematical problems and tricks. $3.00.

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This book is written so that even the tenderfoot can readily understand it. It takes up successively tents, camp furnishings, bedding, clothing, footwear, waterproofing, provisioning, camp making and cookery. $1.00.

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This book covers a wide range of questions children will ask or may be led to sense about the world of nature and things. Answers of a discussion type are supplied. $1.60.

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A system of keeping stamps with their records is suggested. This is a valuable source of help for the collector and may interest others in the hobby of philately. $0.20.

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Included among the many splendid collections which Mr. McMillan discusses are trophies of nature and science, including insects, wild flowers, and shells. The directions in this guide are set forth in admirable fashion, and a full set of illustrations add clarity and interest to the text. $1.75.

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This book was written by an ex-aviator in response to his child's interest. It is a simple story with many pictures that will satisfy the child who has caught an interest in airplanes. Grades 1–4. $2.50.

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The book gives clear advice on how to treat fractures, sprains, dislocations, care for burns, cuts, drowning cases, minor accidents, camp diseases and snake bites. Instructions for the camp medicine chest are included. $1.00.

PINKERTON, KATHERINE. *Woodcraft for Women.* The Macmillan Co., 60 Fifth Ave., New York.
This book by an experienced camper gives clear suggestions on woods clothing, packs and packing, tents and camp making, cooking, paddling, hunting, fishing, the winter woods and going alone. $1.00.

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This explains the way any one can mount his prize fish, bird, or game animal. It demonstrates the steps to take with many clear illustrations and tells the special points necessary in mounting birds, small mammals, fishes, reptiles, deer heads, etc. $1.00.

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This book covers the whole field of collecting, preparing, preserving, and methods of exhibiting. The author is noted for this type of work. Grade 7 up. $7.50.

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This is a sort of handbook of the out-of-doors. The author deals with out-of-door life in a fascinating way, with sections on trees, birds, Indian law, stars, camping, etc., and is suitable for boys and girls from 9 years up.

SOLAR, FRANK I. *Hand Craft Projects.* The Bruce Publishing Co., 524–544 Milwaukee St., Milwaukee, Wisconsin.
This is published in three volumes, Book I—1931, Book II—1931, Book III—1931. They are filled with original and interesting projects, some easy to make, others a little more difficult. Descriptions are clear and diagrams helpful. Grades 4–9. Each $1.25.

STAFFORD, JUSTIN, AND ESTY, LUCIEN, Editors. *Ask Me Another. The Question Book.* The Viking Press, 30 Irving Place, New York.

This is another question and answer book covering a wide range of questions children will ask or might ask about the commonly observed phenomena. The answers will satisfy the intellectual needs of children. $1.60.

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These are essays from The Maine Woods—a forest classic. In all that Thoreau says, he stimulates a love not only for nature, but for simple ways of living. Grades 7–9. $0.28.

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This contains a study of the constellations, eleven star maps, how to know the clouds and trees and weather and a study of the solar system. $1.75.

WADE, MARY HAZELTON. *The Boy Who Found Out.* D. Appleton & Co., 35 West 32nd St., New York. 1928.

This tells simply and dramatically the story of the great French naturalist, Henri Fabre—of his toil and struggle, his wonderful accomplishment, and of the just honors which were eventually heaped upon him. The narrative is an absorbing one for the young reader. Illustrated. $1.75.

WEIR, L. H. *Camping Out, a Manual on Organized Camping.* The Macmillan Co., 60 Fifth Ave., New York.

This is one of the most comprehensive and detailed volumes on the subject of camping. It is a compendium of all phases of the subject. Each phase is written by an expert in his particular field. $2.00.

WHEELER, IDA W. *Playing With Clay.* The Macmillan Co., 60 Fifth Ave., New York. 1928.

This is a simple story of the arts of pottery and sculpture from the days of the primitive cave child to Michael Angelo. It gives simple directions for making clay objects. It contains photographs and many line cuts, diagrams and patterns. Grades 4–6. $1.50.

WILHELM, LEILA M. *With Scissors and Paste.* The Macmillan Co., 60 Fifth Ave., New York City. 1927.

This is a book of toy-making for little children. Some of the things of an entertaining and instructive nature that can be made are: Animals that stand up, A toy village, Automobiles, Express carts, Trains, etc. It is fully illustrated with many patterns. Grades 1–3. $1.73.

SCIENCE READING MATERIALS FOR PUPILS AND TEACHERS

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In the depression years that have followed the publication of the first bibliography in 1931–32, there has been a decrease in the number of science books published. The depression has had its good points in that the quality and character of the books published have been on a higher plane because the publishers have scrutinized more carefully than normally the sales possibilities, which on the average and in the long run, are determined by the merits of the publication. The authors and editors have been able to devote more time to presenting subject matter in a form that is more teachable in the classroom. New textbooks emphasize the most effective methods that are being followed by the best teachers of today. There has also been a great improvement in the physical characteristics of the newer books—excellent waterproof and verminproof covers, dull finish paper on which illustrations can be better printed; more attention to pertinent illustrations, colored photographs of outstanding merit, and utilization of a more readable type.

While this is not a brief for the publisher, we, as educators, sometimes forget that the publisher is an important factor in the advancement of education. Were it not for their adventuresome spirit, many books, now available, would not have been published. Admitting that publishers are not guided wholly by Utopian motives, the truth is that probably more than fifty per cent of the books published do not pay the costs of publication.

Short-sighted school administrators and penny-wise school boards abetted by the Economy Leaguers, Chicago's Gold Coast, and other similar groups, have allowed so-called economy to hamper the education of the young. With a million more pupils than in 1930, the sale of textbooks has dropped by over a third. This can only mean that youngsters are using dog-eared, dirty books, crudely defaced, often with missing pages, obsolete, and sometimes disease-infested books. Often pupils have no books except during recitation periods, and sometimes even not then.

Many schools have resurrected books of ancient vintage—textbooks in physiology and zoology published thirty years ago, chemistry texts dating back to the time of the Curies' discovery of radium and long antedating the inclusion of the concept of the electronic structure of matter. "No money with which to buy necessary books" is the position taken by some school administrators and school boards, and yet we spent only nine-tenths of one per cent of our educational dollar for schoolbooks in 1934 and more than five million weekly for movies! Even in the boom days of Coolidge, we spent only one and six-tenths of our educational dollar for books and reading materials.

A well-equipped library is essential even to a competent teacher, and in the case of the incompetent teacher it is the student's only protection against stupidity, apathy, and ignorance. The library of the average school is pitifully inadequate. In many schools the total budget for library books and magazines has been reduced to zero and the teachers themselves spend nothing in the way of professional reading. Small wonder such schools see no need for library reading materials. But to science teachers and schools desiring up-to-date, modern science textbooks and supplementary reading materials, there is an excellent array of material from which to make a selection.

PART I. TEACHER REFERENCES

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Wonders of Sea Life. 1934. (6 Vols.) $0.65 each.

DuPuy, William Atherton. *Wonders of the Plant World.* Heath, 1931. 196 p. $0.88. (December, '32).

Fenton, Carroll Lane. *Along the Hill.* Reynal, 1935. 96 p. $2.00.

Fuller, Raymond T. *Along the Brook.* Day, 1931. 81 p. $1.50. (April, '34).

Kenly, Julie Closson. *The Astonishing Ant.* Appleton, 1931. 251 p. $2.50. (April, '32).

Pack, Charles L. and Gill, Tom F. *Forest Facts for Schools.* Macmillan, 1931. 336 p. $0.80. (December, '33).

C. CHEMISTRY

Collins, A. Frederick. *The Metals.* Appleton, 1932. 310 p. $2.00. (December, '33).

———. *How to Understand Chemistry.* Appleton, 1932. 322 p. $2.00. (February, '34).

Ehrenfeld, Louis. *The Story of Common Things.* Minton, 1932. 203 p. $2.50. (October, '33).

Holmes, Harry N. *Out of the Test Tube.* Long, 1934. 373 p. $3.00. October, '35).

D. GENERAL

Collins, A. Frederick. *New World of Science.* Lippincott, 1934. 308 p. $2.50.

Davis, Watson. *Science Today.* Harcourt, 1931. 310 p. $2.50. (December, '32).

Ditmar's Raymond and Bridges, William. *Snake Hunter's Holiday.* Appleton, 1935. 309 p. $3.50.

———. *The Forest of Adventure.* Macmillan, 1933. 258 p. $2.50.

———. *Thrills of a Naturalist's Quest.* Macmillan, 1932. 268 p. $3.50. (October, '33).

———. *Strange Animals I Have Known.* Warren, 1931. 375 p. $3.50. (December, '32).

Felix, Edgar H. *Television.* McGraw, 1931. 272 p. $2.50. (April, '32).

Hawks, Ellison. *Book of Natural Wonders.* Loring, 1935. 256 p. $2.00.

Hunter, George W. and Whitford, Robert C. *Readings in Science.* Macmillan, 1931. 283 p. $1.60. (December, '31).

Huxley, Julian and Andrade, E. N. daC. *Simple Science.* Harpers, 1935. 688 p. $3.50.

Hylander, C. J. *Cruisers of the Air.* Macmillan, 1931. 308 p. $2.50. (February, '32).

Ilin, M. *100,000 Whys.* Lippincott, 1933. 138 p. $1.50. (October, '34).

Kane, Joseph Nathan. *Famous First Facts.* Wilson, 1933. 757 p. (October, '35).

Miller, Frances T. *Thomas A. Edison: Benefactor of Mankind.* Winston, 1931. 320 p. $1.50. (December, '32).

Moseley, E. L. *Trees, Stars and Birds.* World, 1935. 418 p. $1.60.

Wead, Frank. *Wings for Men.* Century, 1932. $4.00. (October, '32).

Webster, Hanson H. *The World's Messengers.* Mifflin, 1934. 342 p. $1.04. (April, '35).

Wise, W. E. *Thomas Alva Edison: The Youth and His Times.* Rand, 1933. 230 p. $2.00. (April, '34).

Woodbury, David O. *Communication.* Dodd, 1931. 280 p. $2.50. (April, '32).

E. PHYSICS

Clark, W. M. *Manual of Mechanical Movements.* Clark, 1933. 122 p. $1.00. (December, '33).

Collins, A. Frederick. *Fun With Electricity* Appleton, 1935. $2.00.

Hawks, Ellison. *The Book of Electrical Wonders.* Dial, 1931. 316 p. $3.00. (October, '32).

Morgan, Alfred Powell. *First Electrical Book for Boys.* Scribners, 1935. 209 p. $2.50.

PART IV. ELEMENTARY SCIENCE

A. PRIMARY GRADES

Agnew, Kate E. and Coble, Margaret. *Baby Animals on the Farm.* World, 1933. 153 p. $0.68. (December, '35).

Anonymous. *Animal Pictures and Rhymes.* Stern, 1934. 35 p.

Ashbrook, Frank G. *Furry Friends.* Whitman, 1932. $0.10.

Beaty, John Y. *Story Picture of Farm Animals.* Beckley, 1934. 155 p. $0.70.

———. *Story Picture of Farm Foods.* Beckley, 1935. 192 p. $0.70.

———. *The Farmer at His Work.* Saalfield, 1934. $0.10.

Beaty, John Y. and Allen J. C. *On Our Farm.* Saalfield, 1932. $0.10. (October, '34).

Beauchamp, W. L., Mathews, Florence and Gray, William S. *I Wonder Why. Science Stories,* Books I and II. Reilly, 1933. 1934. 144 p. 176 p. $1.00 each.

Beauchamp, W. L., Crampton, Gertrude and Gray, William S. *Science Stories.* Book I. Foresman, 1933. 144 p. $0.60. (December, '34).

———. *Science Stories.* Book II. Foresman, 1935. 176 p. $0.68.

Craig, Gerald S. and Baldwin, Sarah. *Our Wide, Wide World.* Ginn, 1932. 306 p. $0.76. (October, '32).

———. *Out of Doors.* Ginn, 1932. 269 p. $0.76. (October, '32).

Craig, Gerald C. and Burke, Agnes. *We Look About Us.* Ginn, 1932. 175 p. $0.76. (October, '32).

Fisher, Clyde and Langham, Marian L. *Nature Science: Book I, World of Nature.* 93 p. Book II, *Ways of the Wild Folk.* 117 p. Noble, 1934. $1.20 each. (October, '35).

Homer, O. Stuart and Homer, Anna M. *Our Farm Babies.* McKnight, 1934. 133 p. $0.80.

———. *Other Farm Babies.* McKnight, 1934. 136 p. $0.80.

Kelliher, Alice V. and Zirbes, Laura. *Animal Tales.* Keystone, 1930, 85 p.

Patch, Edith M. and Howe, Harrison E. *Nature and Science Readers.* Book I, *Hunting.* 1932. 161 p. $0.80. Book II, *Outdoor Visits.* 1932. 212 p. $0.84. Macmillan. (April, '33).

Towse, Anna B., Gray, William S. and Mathews, Florence E. *Health Stories.* Book I, 1934. 144 p. $0.60. (December, '34). Book II, 1934. 176 p. $0.68. Foresman.

Shankland, Frank N. and Peat, Fern B. *Birds.* Whitman, 1932. $0.10. (October, '34).

Thorne, Diana. *Dogs. Baby Animals.* Whitman, 1932. $0.10 each. (October, '34).

Walter, Eleanor D. and Roberts, Helen. *Bugs.* Whitman, 1932. $0.10. (October, '34).

Zirbes, Laura and Keliher, Alice V. *The Book of Pets.* Keystone, 1932. 102 p. $0.58.

Zirbes, Laura and Wesley, M. *Story of Milk.* Keystone, 1926. 79 p. $0.58.

B. INTERMEDIATE GRADES

Bertelli, Luigi. *The Emperor of the Ants.* Crowell, 1935. 240 p. $1.50.

Burgess, Thornton W. *The Burgess Big Book of Green Meadow Stories.* Brown, 1932. 202 p. $1.75. (October, '34).

Bronson, Wilfred S. *Paddlewings: The Penguins of Galapagos.* Macmillan, 1931. 106 p. $2.00. (October, '33).

———. *Polliwiggle's Progress.* Macmillan, 1932. 122 p. $2.00. (October, '33).

Cormack, Maribelle and Alexander, William. *The Museum Comes to Life.* American, 1931. 207 p. $0.76. (October, '32).

Craig, Gerald S. and Condry, Margaret. *Learning About Our World.* Ginn, 1932. 384 p. $0.76. (October, '32).

——— and Hurley, B. D. *Earth and Living Things.* Ginn, 1932. 308 p. $0.76. (October, '32).

——— and Johnson, Goldie M. *Our Earth and Its Story.* Ginn, 1932. 462 p. $0.76. (October, '32).

Dukelow, Jean H. and Webster, Hanson H. *The Ship Book.* Mifflin, 1931. 280 p. $2.00. (October, '34).

Engleman, F. E. and Salmon, Julia. *Airways.* Heath, 1931. 180 p. $0.80. (October, '32).

Our Changing World Series. Nelson, 1934. $0.50 each.

- Edholm, Lizette M. *Ship Ahoy.* 78 p.
- Evans, Wainwright. *The Thunder Bird.* 70 p.
- Haynes, Muriel. *Our Electric World.* 67 p.
- Lipman, Michael. *How Men Have Kept Their Records.* 60 p.
- Phelan, Margaret. *Candlelight Tales.* 68 p.
- Stout, Velma. *Wires Round the World.* 52 p.

Fisher, Clyde and Langham, Marion L. *Nature Science Book III, Our Wonder World.* 113 p. *Book IV, Field and Garden.* Noble. 115 p. $1.20 each. (October, '35).

Kenly, Julie Closson. *Children of a Star.* Appleton, 1932. 238 p. $2.50. (October, '33).

———. *Wild Wings.* Appleton, 1933. 275 p. $2.50. (February, '34).

King, Julius. *Birds.* Books I, II, and III. Harter, 61 p. each. $0.10.

Lent, Henry B. *Diggers and Builders.* Macmillan, 1931. 68 p. $2.00. (October, '33).

Marcy, Clarence A., Marcy, F. L., Corwin, Mal J. and Corwin, Walling. *Western Nature Science Stories: I, The Indian's Garden,* 212 p. *II, The Padre's Garden,* 212 p. *III, The Pioneer's Pathway,* 211 p. *IV, Trails Today,* 211 p. Wagner, 1932. $1.00 each. (February, '34).

Nida, William L. *Man Conquers the World with Science.* Albert, 1934. 256 p. $1.25.

Patch, Edith. *Science at Home.* Macmillan, 1934. 450 p. $0.92. (April, '35).

———. *Nature and Science Readers:* III, *Surprises.* 307 p. $0.84. IV, *Through Four Seasons.* 331 p. $0.88. Macmillan, 1933. (February, '34).

——— and Fenton, C. L. *Holiday Shore.* Macmillan, 1935. 150 p. $2.00. (October, '35).

——— and Howe, Harrison E. *The Work of Scientists.* Macmillan, 1935. 488 p. $0.76.

Rarig, Frances H. *The Ant Queen's Home and Other Stories.* Heath, 1932. 170 p. $0.80. (April, '34).

Reed, W. Maxwell. *The Stars for Sam.* Harcourt, 1931. 190 p. $3.00. (October, '33).

———. *The Earth for Sam.* Harcourt, 1930. 390 p. $3.50. (October, '33).

Smith, Jeanette. *A Summer by the Sea.* America, 1935. 135 p. $0.52.

Towse, Anna B., Mathews, Florence E. and Gray, William S. *Health Stories.* Book III. Foresman, 1935. 208 p. $0.76.

Walker, Hattie A. *Read a New Story Now.* Beckley, 1935. 152 p. $0.70.

PART V. JUNIOR HIGH SCHOOL

Bock, George E. *What Makes the Wheels Go Round?* Macmillan, 1931. 76 p. $2.00. (October, '33).

Boulton, Rudyerd. *Traveling with the Birds.* Donohue, 1933. 64 p. $1.50.

Collins, A. Frederick. *How to Understand Electricity.* Lippincott, 1935. 326 p. $2.50.

Ditmars, Raymond L. and Carter, Helene. *The Book of Zoography.* Lippincott, 1934. 64 p. $2.00.

———. *Books of Prehistoric Animals.* Lippincott, 1935. 64 p. $2.00.

Dougan, Lewis M. *Stories of Outdoor Science.* Lyons, 1933. 357 p. $0.80. (December, '34).

Fraser, Chelsea. *Heroes of the Air.* Crowell, 1932. 648 p. $2.50. (October, '34).

———. *The Story of Aircraft.* Crowell, 1933. 492 p. $2.50. (October, '34).

———. *The Model Aircraft Builder.* Crowell, 1931. 384 p. $2.50.

Harney, Laura B. *The Skycraft Book.* Heath, 1932. 338 p. $1.08. (October, '32).

Hawks, Ellison. *The Romance of Transportation.* Crowell, 1931. 333 p. $3.00. (April, '32).

———. *The Romance of the Merchant Ship.* Crowell, 1931. 320 p. $3.00. (October, '33).

Huey, E. G. *A Child's Story of the Animal World.* Reynal, 1933. 355 p. $3.50.

Hoyt, Vance Joseph. *Malibu.* Lothrop, 1931. 272 p. $2.00.

———. *Zorra.* Lothrop, 1933. 125 p. $1.50.

———. *Bar-rac.* Lothrop, 1931. 111 p. $1.50.

Petersham, Maud and Miska. Winston, 1935. 32 p. each. $0.60 each. *The Story Book of Clothes; The Story Book of Houses; The Story Book of Coal; The Story Book of Transportation; The Story Book of Food; The Story Book of Gold; The Story Book of Ships; The Story Book of Trains; The Story Book of Aircraft; The Story Book of Oil; The Story Book of Iron and Steel; The Story Book of Wheels.*

Post, Augustus. *Skycraft.* Oxford, 1933. 276 p. $1.50. (October, '34).

Peattie, Roderick. *Rambles in Europe.* American, 1934. 247 p. $0.72.

Reh, Frank. *Science Related to Life*: I, *Water, Air and Sound.* 181 p. II, *Heat and Health.* 192 p. III, *Magnetism and Electricity.* 200 p. IV, *Light Forces and Machines.* American, 1932. $0.60 each. (February, '34).

Robinson, W. W. *Beasts of the Tar Pits.* Macmillan, 1932. 46 p. $1.75. (October, '33).

Schmidt, Karl P. *Homes and Habits of Wild Animals.* Donohue, 1934. 64 p. $1.50.

Simonds, William A. *Edison, His Life, His Work, His Genius.* Bobbs, 1934. 364 p. $3.50. (December, '35).

Snyder, H. Rossiter. Creatures Great and *Small.* Loring, 1935. 78 p. $2.00.

St. Clair, Labert. *Transportation.* Dodd, 1933. 349 p. $2.50.

Washburne, Carleton and Washburne, Heluiz. *The Story of Earth and Sky.* Appleton, 1933. 368 p. $3.50. (April, '35).

Webster, Hanson H. *Travel.* Mifflin, 1933. 440 p. $2.00. (October, '34).

PART VI. HIGH SCHOOL TEXTBOOKS

A. Biology

Baker, Arthur O. and Mills, H. *Dynamic Biology.* Rand, 1933. 722 p. $1.72. (February, '34).

Corwin, Walling and Corwin, Mae Johnson. *Living Things.* Blakiston, 681 p. $1.68.

Curtis, Francis D., Caldwell, Otis and Sherman, N. H. *Biology for Today.* Ginn, 1934. 733 p. $1.76. (October, '34).

Fitzpatrick, Frederick L. and Horton, Ralph E. *Biology.* Mifflin, 1935. 611 p. $1.76. (October, '35).

Hegner, Robert W. *Practical Zoology.* Macmillan, 1931. 561 p. $1.80. (October, '32).

Kinsey, Alfred C. *New Introduction to Biology.* Lippincott, 1933. 840 p. $1.68. (April, '34).

Mank, Helen G. *The Living World.* Sanborn, 1933. 673 p. $1.68. (April, '34).

Moon, T. J. and Mann, P. B. *Biology for Beginners.* Holt, 1933. $1.72.

Peabody, J. C. and Hunt, A. E. *Biology and Human Welfare.* Macmillan, 1933. 640 p. $1.60. (April, '35).

Pieper, Charles J., Beauchamp, Wilbur L. and Frank, Orlin. *Everyday Problems in Biology.* Foresman, 1932. 686 p. $1.60. (December, '32).

Robbins, Wilfred W. and Isenborger, Jerome. *Practical Problems in Botany.* Wiley, 1936. 402 p. $2.00.

Smallwood, W. M., Reveley, Ida L. and Bailey, Guy. *New Biology.* Allyn, 1934. 636 p.

Wheat, Frank Merrill and Fitzpatrick, Elizabeth. *General Biology.* American, 1932. 566 p. $1.60. (December, '32).

———. *Everyday Problems in Health.* American, 1933. 440 p. $1.20. (December, '33).

B. Chemistry

Bradbury, R. H. *First Book in Chemistry.* Appleton, 1934. $1.80.

Brownlee, Raymond B., Fuller, Robert W., Hancock, William J., Sohon, Michael D. and Whitsit, Jesse E. *First Principles of Chemistry.* Allyn, 1935. 813 p. $1.80.

Bruce, George H. *High School Chemistry.* World, 1933. 550 p. $1.60. (April, '35).

DINSMORE, ERNEST L. *Chemistry for Secondary Schools.* Laurel, 1931. 164 p. $2.00. (October, '33).

HESSLER, JOHN C. *The First Year of Chemistry.* Sanborn, 1931. 544 p. $1.68. (October, '33).

HOWARD, RUSSELL S. *Units in Chemistry.* Holt, 1934. 832 p. $1.80. (December, '34).

JAFFEE, BERNARD. *New World of Chemistry.* Silver, 1935. 596 p. $1.80. (December, '35).

C. GENERAL SCIENCE

CARPENTER, HARRY A. and WOOD, GEORGE. *Our Environment: Its Relation to Us.* 1933. 407 p. $1.20. (October, '34); *Our Environment: How We Adapt Ourselves to It.* 1934. 539 p. $1.50. (February, '35). Allyn.

CLEMENT, ARTHUR C., COLLISTER, MORTON C. and THURSTON, ERNEST L. *Our Surroundings.* Iroquois, 1931. 628 p. $1.68. (October, '34).

CORWIN, MAE JOHNSON and CORWIN, WALLING. *Junior High School Science.* Wagner, 1931. 392 p. $1.60. (February, '34).

CORWIN, WALLING and CORWIN, MAE JOHNSON. *The Science of Human Living.* 464 p. $1.68.

———. *The Science of Plant and Animal Life.* 592 p. $1.72.

———. *The Science of Discovery and Invention: Physical Science.* 735 p. $1.80. Wagner, 1931. (February, '32).

HUNTER, GEORGE W. and WHITMAN, WALTER G. *My Own Science Problems* (7th year). 431 p. $1.20. *Science in Our Social Life* (8th year). 452 p. $1.28. *Science in Our World of Progress* (9th year). 581 p. $1.60. American, 1935. (October, '35).

LAKE, CHARLES H., HARLEY, H. P. and WELTON, LOUIS H. *Exploring the World of Science.* Silver, 1934. 702 p. $1.76. (October, '34).

OBOURN, ELLSWORTH S. and HEISS, ELWOOD D. *Science Problems of Modern Life.* Book I, 201 p. Book II, 184 p. Webster, 1933. $0.42 each. (December, '33).

PIEPER, CHARLES JOHN, and BEAUCHAMP, WILBUR LEE. *Everyday Problems in Science.* Foresman, 1933. 734 p. $1.60. (December, '33).

POWERS, S. R., NEUNER, ELSIE and BRUNER, H. B. *The World Around Us.* 1934. 475 p. $1.20. (October, '34). *This Changing World.* 1934. 561 p. $1.40. (December, '34). *Man's Control of His Environment.* 1935. 753 p. $1.60. (April, '36). Ginn.

REGENSTEIN, ANNA B. and TEETERS, WILLIAM RAY. *Science at Work.* Rand, 1935. 628 p. $1.68. (February, '36).

SKILLING, WILLIAM T. *Tours Through the World of Science.* McGraw, 1933. 758 p. $1.70. (December, '33).

WATKINS, RALPH K. and BEDELL, RALPH C. *General Science for Today.* Macmillan, 1932. 653 p. $1.68. (December, '32).

WEBB, HANOR, A. and BEAUCHAMP, ROBERT O. *Science by Observation and Experiment.* Appleton, 1935. 721 p. $1.72. (October, '35).

WEED, HENRY I. and REXFORD, FRANK A. *Useful Science.* Book II. Winston, 1931. 435 p. (October, '33).

WEED, HENRY I. and REXFORD, FRANK A. and CARROLL, FRANKLIN B. *Useful Science for High School.* Winston, 1935. 707 p. $1.70.

WOOD, GEORGE and CARPENTER, HARRY A. *Our Environment: How We Use and Control It.* Allyn, 1934. 846 p. $1.80. (February, '35).

D. PHYSICS

BUTLER, ALFRED M. *Foundation of Physics.* Barrows, 1934. 613 p. $2.00.

DULL, CHARLES E. *Modern Physics.* Holt, 1934. 747 p. $1.80.

FULLER, ROBERT W., BROWNLEE, RAYMOND B. and BAKER, D. LEE. *First Principles of Physics.* Allyn, 1934. 303 p. $1.00. (December, '32).

HENDERSON, W. D. *New Physics in Everyday Life.* Lyons, 1935. $1.60.

HOLLEY, CLIFFORD, and LOHR, VIRGIL C. *Mastery Units in Physics.* Lippincott, 1932. 700 p. $1.68. (October, '32).

SEARS, FREDERICK E. *Essentials of Physics.* Laurel, 1931. 583 p. $1.32. (October, '33).

STEWART, OSCAR M., CUSHING, BURTON L. and TOWNE, JUDSON R. *Physics for Secondary Schools.* Ginn, 1932. 736 p. $1.72. (December, '32).

WHITMAN, WALTER G. *Household Physics.* Wiley, 1932. 502 p. $2.75. (December, '32).

PART VII. WORKBOOKS

A. BIOLOGY

BAKER, ARTHUR O. and MILLS, LEWIS H. *Activities for Dynamic Biology.* Rand, 1933. 218 p. $0.80. (October, '34).

BEAUCHAMP, WILBUR L. *A Study in Biology.* Foresman, 1934. 259 p. $0.80. (December, '34).

BLAISDELL, J. GLENN. *Exercise Book in High School Biology.* World, 1933. 167 p. $0.72. (December, '33).

DOWNING, E. R. and MCATEE, VEVA M. *Problem Solving in Biology.* Lyons, 1934. 215 p. $0.80. (February, '35).

FITZPATRICK, FREDERICK L. and HORTON, RALPH E. *Student's Manual in Biology.* Mifflin, 1035. 155 p. $0.48. (February, '36).

HUNTER, GEORGE W. *Laboratory Problems in Biology.* American, 1932. 325 p. $0.60. (December, '32).

MANK, HELEN G. *Adventures in Thinking.* Sanborn, 1935. 348 p. $1.00.

PEABODY, JAMES EDWARD. *Work-test Book to Accompany Biology and Human Welfare.* Macmillan, 1934. 158 p. $0.40. (December, '34).

SNYDER, EMILY B. and DUDLESTON, JOSEPH J. *Biology Demonstration and Assignment Book.* Singer, 1932. 216 p. $0.69. (December, '34).

B. CHEMISTRY

AMES, MAURICE U. and JAFFE, BERNARD. *Laboratory and Workbook Units in Chemistry.* Silver, 1934. 228 p. $0.84.

BROWNLEE, RAYMOND B. *et al. Laboratory Experiments in Chemistry.* Allyn, 1935. 299 p. $1.00.

BURDICK, A. J. and DUDLESTON, J. J. *Chemistry Experiments and Exercises.* Singer, 1933. 200 p. $0.69. (October, '34).

CARLETON, ROBERT H. and CARPENTER, FLOYD G. *Comprehensive Units in Chemistry.* Lippincott, 1935. 420 p. $1.20. (October, '35).

DOWNING, M. M. and BRADBURY, G. M. *Problems and Experiments in Chemistry for Girls.* Bradbury, 1934. 169 p.

DULL, CHARLES E. *Chemistry Workbook.* Holt, 1935. $0.88.

FLIEDNER, LEONARD J. *Chemistry Workbook.* Globe, 1932. 35 p. $0.20. (October, '34).

HESSLER, JOHN C. *Workbook Manual of First Year Chemistry.* Sanborn, 1934. 330 p.

MCGILL, M. V. and BRADBURY, G. M. *Chemistry Workbook and Laboratory Guide.* Lyons, 1935. 374 p. $1.00. (December, '35).

C. GENERAL SCIENCE

BEAUCHAMP, WILBUR L. and MILLER, HAROLD. *A Study Book in General Science.* Foresman, 1935. 335 p. $0.80.

BOYER, PHILLIP A. *et al. A Learning Guide in General Science.* Lyons, 1935. 335 p. $0.96. (December, '35).

CARPENTER, HARRY A. and WOOD, GEORGE C. *Science Discovery Book.* Allyn, 1933. 159 p. $0.55.

HESSLER, JOHN C. *Workbook Manual for First Year Science.* Sanborn, 1935. 196 p.

HUNTER, GEORGE W. and WHITMAN, WALTER G. *Workbook for Problems in General Science.* American, 1932. 336 p. $0.60. (February, '33).

———. *Laboratory Exercises for My Own Science Problems.* American, 1935. 168 p. $0.44.

———. *Laboratory Exercises for Science in Our Social Life.* American, 1935. 180 p. $0.48

———. *Laboratory Exercises for Science in Our World of Progress.* American, 1935. 232 p. $0.60

LAKE, CHARLES H., WELTON, LOUIS E. and ODELL, JAMES C. *General Science Workbook.* Silver, 1932. 346 p. $0.80. (December, '34).

OBOURN, ELLSWORTH S. and HEISS, ELWOOD D. *Science Problems of Modern Life.* Book I, 201 p. Book II, 184 p. Webster, 1933. (December, '33).

POWERS, S. R., NEUNER, ELSIE, and BRUNER, H. B. *Directed Activities. I. The World Around Us.* Ginn, 1935. 113 p. $0.40. (April, '36).

D. PHYSICS

BURDICK, A. J. and DUDLESTON, J. J. *Physics Experiments and Problems.* Singer, 1932. 184 p. $0.69. (October, '34).

DULL, CHARLES E. *Physics Workbook.* Holt, 1934. 345 p. $0.88.

FULLER, ROBERT W., BROWNLEE, RAYMOND B. and BAKER, D. LEE. *Laboratory Exercises to Accompany First Principles of Physics.* Allyn, 1934. 303 p. $1.00.

HENDERSON, W. D. *Physics Guide and Laboratory Manual.* Lyons, 1933. $1.00. (April, '34).

POWERS, SAMUEL RALPH and BROWN, H. EMMETT. *Workbook in Physics.* Allyn, 1932. 303 p. $0.80. (February, '33).

PART VIII. TESTS

A. BIOLOGY

FITZPATRICK, FREDERICK L. and POWERS, S. RALPH. *Cooperative Biology Test*—(several series). Cooperative, 1933–1936. (October, '34).

HUNTER, GEORGE W. and KITCH, L. W. *Mastery Tests in Biology. Sets X and Y.* American, 135 p. each. $0.40 each. (October, '34).

PIEPER, CHARLES J., BEAUCHAMP, W. L. and FRANK, O. D. *Objective Unit Tests on Everyday Problems in Biology.* Foresman, 1934. 48 p. $0.28. (February, '35).

B. CHEMISTRY

BRADBURY, G. M. and MCGILL, M. V. *The Twentieth Century Practice-Exercises and Objective Tests in Chemistry.* Benton, 132 p. $0.25. (October, '33).

CARPENTER, F. F. and CARLETON, R. H. *Comprehensive Mastery Tests in Chemistry to Accompany Comprehensive Units in Chemistry.* Lippincott, 1935. 24 p.

FOWLER, GEORGE W. and KANE, EMMET P. *Mastery Tests in Chemistry.* Ginn, 1932. (October, '33).

MALIN, J. E. *Diagnostic Tests in Mechanics of High School Chemistry.* Public, 1932. $0.15. (December, '33).

NOLL, VICTOR H. and POWERS, S. RALPH. *Cooperative Chemistry Test*—(several series). Cooperative, 1933–1936. (October, '34).

PERSING, K. M. *Laboratory Chemistry Tests.* Public. $0.15. (April, '32).

POWERS, S. RALPH and JETTE, ERIC R. *Columbia Research Bureau Chemistry Tests—Forms A and B.* World, $0.20.

C. GENERAL SCIENCE

BEDELL, RALPH C. and WATKINS, RALPH K. *Kansas City General Science Tests.* Webster, 1932. (February, '34).

BOYER, PHILIP A. and GORDON, HANS. *General Science Unit Tests.* Lyons, 1934. $0.18. (February, '35).

Glenn, Earl R. and Gruenberg, Benjamin C. *Instructional Tests in General Science.* World, 1932. 92 p. $0.36. (February, '33).

Hunter, George W. and Knapp, Roy A. *Mastery Tests in General Science. Set X,* 154 p. *Set Y,* 163 p. American, 1934. $0.40 each. (February, '35).

Pieper, Charles J. and Beauchamp, Wilbur L. *Objective Unit Tests on Everyday Problems in Science.* Foresman, 1934. 68 p. $0.28. (February, '35).

Underhill, Orra L. and Powers, S. Ralph. *Cooperative General Science Test*—(several series). Cooperative, 1933–1936. (October, '34).

D. PHYSICS

Farwell, Hermon W. and Powers, S. Ralph. *Cooperative Tests in Physics* (several series). Cooperative, 1933–1936. (October, '34).

Farwell, Hermon W. and Wood, Ben D. *Columbia Research Bureau Physics Test. Forms A and B.* World.

Kilzer, L. R. and Kirby, T. J. *Inventory Test for Mathematics of High School Physics.* Public, $0.15. (April, '32).

Kirkpatrick, J. E. and Greene, Harry A. *Pupil-Teacher Handbook of Objective Test Exercises in High School Physics.* Public, 1931. (October, '32).

Sangren, Paul V. and Marburger, Walter G. *Michigan Instructional Tests in Physics.* Public, $0.10. (April, '32).

Stewart, A. W. and Ashbaugh, E. J. *Physics Tests.* Public, $0.15. (April, '32).

E. SCIENTIFIC ATTITUDE

Noll, Victor H. *What Do You Think? Forms 1 and 2.* Bureau, 1935. $0.40. (April, '36).

LIST OF PUBLISHING FIRMS

Albert. Albert Whitman and Company, 560 W. Lake St., Chicago, Ill.

Allyn. Allyn and Bacon, 50 Beacon St., Boston, Mass.

America. The America Press, New York New York.

American. American Book Company, 88 Lexington Ave., New York, N. Y.

Appleton. D. Appleton-Century Company, 35 W. 32nd St., New York, N. Y.

Barrows. M. Barrows and Company, 30 Huntington Ave., Boston, Mass.

Beckley. Beckley-Cardy Company, 1632 Indiana Ave., Chicago, Ill.

Biological. General Biological Supply House, 761–763 E. 69th Place, Chicago, Ill.

Blakiston. P. Blakiston's Son and Company, 1012 S. Walnut St., Philadelphia, Pa.

Blue Ribbon. Blue Ribbon Books, 386 Fourth Ave., New York, N. Y.

Bobbs. Bobbs-Merrill Company, Indianapolis, Indiana.

Bradbury. G. M. Bradbury, Montclair High School, Montclair, N. J.

Brown. Little, Brown and Company, 34 Beacon St., Boston, Mass.

Bureau. Bureau of Publications, Teachers College, Columbia University, New York, N. Y.

Burgess. Burgess Publishing Company, 426 S. Sixth St., Minneapolis, Minn.

Century. See Appleton.

Chemical. Journal of Chemical Education. Easton, Pa.

Chicago. Chicago University Press, Chicago, Ill.

Clark. W. M. Clark, 416 Clark St., South Orange, N. J.

Clute. Willard N. Clute and Company, Indianapolis, Indiana.

Columbia. Columbia University Press, Columbia University, New York, N. Y.

Comstock. Comstock Publishing Company, Cornell Heights, Ithaca, N. Y.

Cooperative. Cooperative Test Service, Columbia University, 500 W. 116th St., New York, N. Y.

Covici. Covici-Friede, 432 Fourth Ave., New York, N. Y.

Crowell. Thomas Y. Crowell Company, 393 Fourth Ave., New York, N. Y.

Day. John Day Company, 386 Fourth Ave., New York, N. Y.

Dial. Dial Press, Inc., 152 W. 13th St., New York, N. Y.

Dodd. Dodd, Mead and Company, 443 Fourth Ave., New York, N. Y.

Donohue. M. A. Donohue and Company, 711 S. Dearborn Ave., Chicago, Ill.

Doubleday. Doubleday, Doran and Company, Garden City, N. Y.

Duffield. See Dodd.

Dutton. E. P. Dutton Company, 286 Fourth Ave., New York, N. Y.

Eastman. Eastman Kodak Company, Rochester, N. Y.

Edwards. Edwards Brothers, Ann Arbor, Michigan.

Falk. Falk Publishing Company, 10 W. 33rd St., New York, N. Y.

Farrar. Farrar and Rinehart, 232 Madison Ave., New York, N. Y.

Follett. Follett Publishing Company, 1255 S. Wabash Ave., Chicago, Ill.

Foresman. Scott, Foresman and Company, 623 S. Wabash Ave., Chicago, Ill.

Frank. J. O. Frank and Sons, Oshkosh, Wisconsin.

Funk. Funk and Wagnalls, 354 Fourth Ave., New York, N. Y.

Garden. Garden City Publishing Company, Garden City, N. Y.

Geographic. National Geographic Society, 16th and Main Streets, N. W. Washington, D. C.

Geographical. American Geographical Society, Broadway and 156th St., New York, N. Y.

GINN. Ginn and Company, 15 Ashburton Place, Boston, Mass.
GLOBE. Globe Book Company, 175 Fifth Ave., New York, N. Y.
HARCOURT. Harcourt, Brace and Company, 383 Madison Ave., New York, N. Y.
HARPERS. Harper and Brothers, 49 E. 33rd St., New York, N. Y.
HARTER. Harter Publishing Company, 2046 E. 71st St., Cleveland, Ohio.
HARVARD. Harvard University Press, Cambridge, Mass.
HEATH. D. C. Heath Company, 1815 Prairie Ave., Chicago, Ill.
HEISS. Elwood D. Heiss, State Teachers College, East Stroudsburg, Pa.
HOLT. Henry Holt and Company, 2626 Prairie Ave., Chicago, Ill.
HURD. Archer W. Hurd, Northern Montana College, Havre, Montana.
ILLINOIS. Bureau of Educational Research, University of Illinois, Urbana, Ill.
IROQUOIS. Iroquois Publishing Company, 106 E. Fayette St., Syracuse, N. Y.
KEYSTONE. Keystone View Company, Meadville, Pa.
KNOPF. Alfred A. Knopf, 730 Fifth Ave., New York, N. Y.
LABORATORY. Laboratory Schools, University of Chicago, Chicago, Ill.
LAUREL. Laurel Book Company, 325 S. Market St., Chicago, Ill.
LIPPINCOTT. J. B. Lippincott Company, 1257 South Wabash Ave., Chicago, Ill.
LIVERIGHT. Liveright Publishing Corporation, 386 Fourth Ave., New York, N. Y.
LONG. Ray Long and Richard R. Smith, 79 Madison Ave., New York, N. Y.
LONGSMAN. Longsman, Green and Company, 114 Fifth Ave., New York, N. Y.
LORING. Loring and Mussey, 152 W. 13th St., New York, N. Y.
LOTHROP. Lothrop, Lee and Shephard, 126 Newberry St., Boston, Mass.
LYONS. Lyons and Carnahan, 76 9th Ave., New York, N. Y.
MCBRIDE. Robert M. McBride and Company, 4 W. 16th St., New York, N. Y.
MCCANN. Coward McCann, 55 Fifth Ave., New York, N. Y.
MCGRAW. McGraw Hill Book Company, 330 W. 42nd St., New York, N. Y.
MCKNIGHT. McKnight and McKnight. Bloomington, Ill.
MACMILLAN. The Macmillan Company, 60 Fifth Ave., New York, N. Y.
MASSACHUSETTS. Board of Education, Boston, Mass.
MIFFLIN. Houghton Mifflin and Company, 2 Park St., Boston, Mass.
MILLS. Clarence A. Mills, College of Medicine, University of Cincinnati, Cincinnati, Ohio.
MINNESOTA. University of Minnesota Press, Minneapolis, Minn.
MINTON. Minton, Balch and Company, 2 W. 45th St., New York, N. Y.
MOSBY. C. V. Mosby Company, 3523 Pine Blvd., St. Louis, Mo.
MUSEUM. Educational Dept., American Museum of Natural History, 77th St. and Central Park West, New York, N. Y.
NELSON. Thomas Nelson and Sons, 381 Fourth Ave., New York, N. Y.
NEW YORK. New York Association of Biology Teachers, Thomas Jefferson High School, Brooklyn, New York.
NOBLE. Noble and Noble, 100 Fifth Ave., New York, N. Y.
NORTH CAROLINA. University of North Carolina Press, Chapel Hill, North Carolina.
NORTON. W. W. Norton and Company, 70 Fifth Ave., New York, N. Y.
NOSTRAND. D. Van Nostrand, 250 Fourth Ave., New York, N. Y.
OHIO STATE. Bureau of Educational Research, The Ohio State University, Columbus, Ohio.
OXFORD. Oxford University Press, 114 Fifth Ave., New York, N. Y.
PENNSYLVANIA. University of Pennsylvania Press, Philadelphia, Pa.
PHARMACY. The Philadelphia College of Pharmacy and Science, Philadelphia, Pa.
PORTER. The Porter Chemical Company, Hagerstown, Md.
PRUITT. Clarence M. Pruitt, Colorado State College of Education, Greeley, Colorado.
PUBLIC. Public School Publishing Company, Bloomington, Ill.
PRENTICE. Prentice Hall, 70 Fifth Ave., New York, N. Y.
PRINCIPIA. Principia Press, Bloomington, Indiana.
PUTNAMS. G. P. Putnam's Sons. 2 West 45th St., New York, N. Y.
RADIO. Radio Technical Publishing Company, New York, N. Y.
RAND. Rand, McNally and Company, 111 8th Ave., New York, N. Y.
REILLY. Reilly and Lee Company, 325 W. Huron St., Chicago, Ill.
REMMERS. H. H. Remmers, Purdue University, La Fayette, Indiana.
RESERVE. Curriculum Laboratory, Western Reserve University, Cleveland, Ohio.
REYNALS. Reynal and Hitchcock, 386 Fourth Ave., New York, N. Y.
ROCK. Rock and Minerals, Peekskill, N. Y.
SAALFIELD. Saalfield Publishing Company, Akron, Ohio.
SANBORN. Benjamin H. Sanborn and Company, 221 E. 20th St., Chicago, Ill.
SAUNDERS. W. B. Saunders Company, Philadelphia, Pa.
SCIENCE. The Science Press, Lancaster, Pa.
SCRIBNERS. Charles Scribner's Sons, 597 Fifth Ave., New York, N. Y.
SEARS. See Dodd, Mead.
SILVER. Silver, Burdett and Company, 39 Division St., Newark, N. J.

Simon. Simon and Schuster, 386 Fourth Ave., New York, N. Y.
Singer. The L. W. Singer Company, Syracuse, N. Y.
Slingerland. Slingerland-Comstock Publishing Company, Ithaca, N. Y.
Stanford. Stanford University Press, Stanford University, Calif.
Stern. Edward Stern and Company, 140 North 6th St., Philadelphia, Pa.
Stokes. Frederick A. Stokes Company, 443 Fourth Ave., New York, N. Y.
Studio. Studio Publications, 381 Fourth Ave., New York, N. Y.
Thomas. Charles C. Thomas, Springfield, Ill.
Union. The Union Library Association, 363 Fourth Ave., New York, N. Y.
University. University Society, 468 Fourth Ave., New York, N. Y.
Vanguard. Vanguard Press, Inc., 100 Fifth Ave., New York, N. Y.
Viking. Viking Press, Inc., 18 E. 48th St., New York, N. Y.
Wagner. Harr Wagner Publishing Company, 609 Mission St., San Francisco, Calif.
Warne. Frederick Warne and Company, 381 Fourth Ave., New York, N. Y.
Warren. Brewer, Warren and Putnam (Out of business).
Washington. Office of Education, Department of Interior, Superintendent of Documents, Washington, D. C.
Whitman. Whitman Publishing Company, Racine, Wis.
Wiley. John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y.
Williams. Williams and Wilkins, Mt. Royal and Guilford Avenues, Baltimore, Md.
Wilson. H. W. Wilson Company, 950 University Ave., New York, N. Y.
Winston. John C. Winston Company, 629 S. Wabash Ave., Chicago, Ill.
World. World Book Company, Yonkers, N. Y.
Wray. School of Education, Penn State College, State College, Pa.
Yale. Yale University Press, New Haven, Conn.

Editorials and educational news

TEACHING THE PRINCIPLES OF SCIENCE

I note that in the editorial of Francis D. Curtis in the December issue, he says "probably no one would be willing to state dogmatically what a principle is." The dictionaries never shirk that responsibility. They seem to agree that a principle or law of science is a statement of a relationship between phenomena, usually a relationship of cause and effect, sometimes a sequence or time relationship.

Scientists have arrived at these laws by a process of generalization, but not all generalizations are laws. All insects have six jointed legs is a generalized fact. One must pick out the essential features after seeing all sorts of watches and generalize on the basis of them to arrive at the definition of the word watch.

It is because we solve most of the problems of a scientific character with which we are faced in life by the application of some known principle or principles of science that the mastery of the most needed of these is so important in school instruction. The problems may be those concerning which we must do something or those we solve just to satisfy our intellectual curiosity.

A principle or law is not mastered when the pupil is able to state it correctly in words. That may be a parrot-like performance. The test of mastery is the ability to select and use the principle needed to solve a problem of the sort that arises in life. E. E. Bayles in his article on the "Limitations of the Morrison Unit," presented in the December, 1934, issue of this journal, says of the eighteen-months-old baby playing in his bath "he expects the hollow celluloid duck to remain on top of the water . . . and . . . the bar of castille soap to go to the bottom." Then he asks "does he not know anything of the flotation principle? Has he no mastery of it?" I should say not in the least. But he is getting experiences that will help to clarify some of the terms in which it may be stated. He similarly asks of the six- or seven-year-old child whom we may get to tell us that heavy things will sink and light things will float, "does he not have an understanding of the principle of flotation." Again I say "No." He does begin to see that flotation is a matter of relative weight but he does not have any idea as yet as to with what the object that is to sink or float must be compared in weight. Nor do I think that the student in the physics class would be entirely at a loss for an answer when asked a question as to how high a balloon of a given density will ascend in the atmosphere. He would reply that it would ascend to a point at which the density of the atmosphere equals that of the balloon. He can not answer in terms of feet and inches, nor could anyone without more data and the mastery of more principles than that of flotation. This student I take it has arrived at the point of mastery though I should be more certain if I might give him a few more problems to solve. I agree with Bayles that much in-

struction must precede mastery. Many terms must be clarified, many subordinate understandings achieved. But to me the point of mastery seems as definite as the boiling point.

Let the teacher who is about to help pupils master a principle make a list of the terms to be clarified, of the subordinate ideas to be acquired and of the teaching devices to be used to accomplish these several items. It will add to the zest of teaching if the instructor will experiment with several classes to see what experiment will put an idea over to pupils most successfully. Suppose I drop the twenty-gram scale weight into a beaker of water. Then take it out and dry it off and drop it into a beaker of mercury. In the first instance it sinks, in the second it floats. Would that help a pupil at the learning stage of Bayles' seven-year-old see what he needed to know? Or would some other experience serve better? Let the instructor keep notes on such questions as arise in his work and of his attempts to answer them experimentally and he will build up in time an experimential background that will make his instruction effective and his job increasingly interesting.

Elliot R. Downing.
University of Chicago

RADIO TALKS ON ELEMENTARY SCIENCE

In a series of four booklets of forty-eight pages each, entitled *This Week Out of Doors in the Penn Country and Beyond,* Edward E. Wildman, Director of Science Education, Philadelphia Public Schools, has brought together in printed form a series of 48 radio talks delivered weekly during 1935.

The dedication of the booklets is quoted:

> To the Teachers in our Public, Parochial, and Private Schools Who Love Nature, and Who Therefore Help Their Pupils to See that the Year's "Big Movie" Is Free to All for the See- and Hearing, This little Record of What is Happening This Week the Year Round Is most Cordially Dedicated by the Author.

> "The world will never starve for want of wonders, but only for want of wonder."—G. K. Chesterton.

The running record of a naturalist's observations and thoughts throughout the year as they were given to his radio audiences will prove to be of real value and inspiration to teachers of nature study and elementary science. Could we but have similar booklets for the various types of regions in the land, we could provide invaluable reading materials for pupils in elementary-school science. A partial index adds to the usability of the booklets for reference purposes.

The booklets are available from the author at twenty-five cents each or one dollar for the set of four in the regular edition. A school and scout edition is announced at seventy-five cents for the set and special rates for ten or more sets.

INTERMEDIATE GRADE SCIENCE

An experimental study of a number of science units is being carried on by the teachers of grades 4, 5 and 6 in the Public Schools of Madison, Wisconsin. In the primary grades science is part of the social science program. The units for the intermediate grades are selected to build upon the understandings of the primary grades. The sequence of units is such that the child is led from a study of his immediate neighborhood and experiences into a large world in time and distance.

The general themes for the three years are stated as follows:

Grade 4—Neighborhood Science.
Grade 5—Knowing and Conserving the Beauty of Our Country.
Grade 6—How the Earth Has Changed.

Teachers participating in this study have selected four or five units to develop and report upon this year. From the combined reports a revised plan will be set up for experimentation by all teachers next year.

U. S. EDUCATIONAL DIRECTORY FOR 1936

The Office of Education announces the completion of Part I of the 1936 Educational Directory on February 21. This bulletin and the other bulletins which comprise the directory are briefly described in the following release from the Office of Education.

Published in record time this year, the five-cent bulletin lists names and addresses of more than 1,000 State school officers and approximately 3,500 county and township public school administrators in the several states.

The U. S. Educational Directory, compiled each year by the Federal Office of Education, is used widely by business houses and agencies dealing with schools and school people. It serves as a useful reference guide in school and other libraries. The Directory is always much in demand, being the most complete guide to America's public school officers published throughout the country.

The four parts making up this year's complete 1936 Educational Directory, which are available from the Superintendent of Documents, Government Printing Office, Washington, D. C., are:

Part I, State and County School Officers, 5c.
Part II, City School Officers, 5c.
Part III, Colleges and Universities, 5c.
Part IV, Educational Associations and Directories, 5c.

MINUTES OF THE SEVENTEENTH ANNUAL MEETING OF THE NATIONAL COUNCIL ON ELEMENTARY SCIENCE

The seventeenth annual meeting of the National Council on Elementary Science was held in the Adam Room of the Hotel Statler, St. Louis, Missouri, on February 22, 1936.

The morning session opened at 9:30 o'clock with the president, Miss Bertha M. Parker, presiding. The papers were presented according to the program published in the February issue of SCIENCE EDUCATION.

Luncheon was served in the Adam Room at noon. The guest speaker, Mr. Henry M. Kennon, Curator of Birds, St. Louis Zoological Park, gave a very instructive presentation of some of the most peculiar activities of birds all over the world.

The afternoon session was given to a symposium on the progress in the teaching of elementary science. G. S. Craig, Teachers College, Columbia University, reported on his experiences in observing science classes in various states and on the trends in curriculum construction, in methods and procedures, and in teacher training in the field of elementary science. Ira C. Davis, University of Wisconsin, told of the work in the elementary science that is being carried on in the state of Wisconsin, how the teachers are made to feel that they have a real part in this work, and of the philosophy underlying the work. Harry A. Carpenter, Rochester, New York, indicated the progress that is being made at present in Rochester in teaching elementary science by radio. Miss Jennie Hall, Minneapolis, next presented an enlightening account of the progress in teaching elementary science in Minneapolis during the last twelve years. The next presentation was an account of progress in Iowa looking to the establishment of elementary science in the schools and was given by Miss Lillian Hethershaw, Drake University. Miss Allegra J. Ingleright, of South Bend, Indiana, told of the curriculum reconstruction in elementary science now going on at South Bend. Miss Mary Melrose, Cleveland, offered suggestions for formulating a course of study in science and also indicated that the radio may be used to multiply the work of a few good teachers. The final discussion was presented by Miss Geraldine Shontz, State Teachers College, Terre Haute, Indiana, who described the elaboration of a unit on dogs at the fifth-grade level.

The annual business meeting was next called to order. The minutes of the previous meeting were read and approved. The following financial report was read by the Secretary-Treasurer and approved.

Report of Treasurer

Receipts

Membership dues:	
from former treasurer	$38.99
direct from members	124.10
For subscriptions:	
to Science Education,	
from former treasurer	3.50
direct from members	7.25
to Science Classroom	.20
to Popular Science Monthly	1.30
to School Science and Mathematics	2.25
to NCES News Notes	.75
Total	$178.34

Expenditures

To Science Education	$10.50
To Popular Science Monthly	1.30
To Science Classroom	.20
To School Science and Mathematics	2.25
To NCES News Notes	.75
For stamps	27.98
For a directory of school principals of New York	.15

For paper	5.83
To Newcomb and Gauss for 200 copies of NCES News Notes	28.50
For express on News Notes and stationery	2.59
For clerical help	11.60
For envelopes	11.76
Refund to Mrs. Anna Gemmill for overpayment on Science Ed.	.25
Refund to Gladys Kotter—paid dues twice	1.00
For 500 programs and 300 directories	38.11
	$142.77
Balance on hand February 22, 1936	35.57

Report of Business Office of NCES News Notes (As of February 13, 1936)

Receipts

Advertising (2 issues)	$94.00
Council membership	7.00
Non-member subscriptions	39.45
Total	$140.45

Expenditures

Postage, supplies, express, cuts, etc.	$41.04
Printing	55.24
To H. A. Cunningham for memberships in Council	7.00
	$103.28
Balance on hand—cash	$37.17
Accounts receivable, advertising	36.50
Accounts receivable plus cash on hand	$73.67
Accounts payable, printing	55.00
Balance	$18.67

Mr. Carpenter reported that the American Science Teachers Association met in St. Louis at the time of the meeting of the A.A.A.S. and that further progress was made in working out the details of this new organization. He indicated that the organization had voted for affiliation with the A.A.A.S., and that it wishes to cooperate with other science organizations. Two types of membership are proposed: direct membership and affiliated membership.

Mr. Whitman reported that the NCES News Notes had been practically self-supporting during the year but stated that, if the publication were to be enlarged, it would seem necessary to draw upon the Council for some fee money to meet the extra expense. Mr. Whitman recommended that the Council consider the advisability of allocating a certain portion of the fee money to the NCES News Notes. It was moved by Miss Jennie Hall and seconded by Miss Mary Melrose that this problem concerning the allocation of money by the Council for the News Notes be referred to the Executive Committee. Motion carried.

The following report of the nominating committee was made by the chairman, Mr. Pieper:

For President, Helen Dolman, Michigan State Normal College, Ypsilanti, Michigan.

For Vice-President, C. L. Thiele, Detroit Public Schools, Detroit, Michigan.

For Secretary-Treasurer, Harry A. Cunningham, Kent State University, Kent, Ohio.

It was moved and seconded that the secretary be instructed to cast a unanimous ballot for the officers recommended by the nominating committee.

Mr. Whitman referred to section 2 of the by-laws which reads that "The members of the nominating committee must . . . be notified by the secretary at least six weeks preceding the annual meeting," and indicated that this rule is impractical. It was moved by Mr. Whitman and seconded by Mr. Thiele that the requirement that the nominating committee be appointed six weeks in advance of the annual meeting be eliminated from Section 2 of the by-laws. Motion carried.

Mr. Cunningham pointed out that, at present, it is difficult to know just when a new membership becomes effective. It was moved by Mr. Van Doren and seconded by Miss Hicks that a new membership by considered as running for one year from the time membership is paid. Motion carried.

In reporting briefly concerning the relationship of Science Education to the Council, Mr. Pieper said that it is desirable to have the NCES representative on the editorial board near the New York editorial office. He reported that the journal has had a very good year.

At the close of the business meeting there was some discussion of a letter to the Council from Miss Parker, a representative of the Audubon Society, regarding cooperation in conservation activities. No formal action was taken. Business meeting adjourned.

Minutes of the Meeting of the Executive Committee

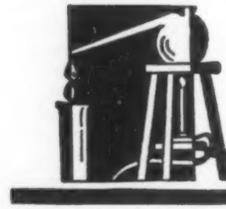
Those in attendance were Helen Dolman, Bertha Parker, W. G. Whitman, C. L. Thiele, and H. A. Cunningham.

It was moved by Mr. Thiele and seconded by Mr. Cunningham that the editorial board for next year be composed of Bertha M. Parker, *Chairman,* W. G. Whitman, Mary Melrose, and Vesta Hicks, and that the secretary notify Miss Melrose and Miss Hicks of their appointment. Motion carried.

It was moved by Mr. Whitman and seconded by Miss Parker that $20.00 be appropriated from the Treasury to the NCES News Notes. Motion carried.

Harry A. Cunningham,
Secretary-Treasurer

Abstracts



GENERAL EDUCATION

Research Division of the National Education Association. "The Teacher's Economic Position." *Research Bulletin of the National Education Association* 13: 165–267; September, 1935.

The scope of this survey can best be seen from the statement of purposes on page 170. "(1) To determine how teachers of different income levels and under various circumstances with respect to sex, material status, living conditions, and number of dependents, actually used their incomes during a period of twelve months; (2) to shed light . . . on the adequacy of the incomes received . . .; (3) to show the sources and amounts of income received . . . in addition to their salaries; (4) to reveal the amounts of property and of indebtedness accumulated . . .; (5) to measure changes in teachers' cost of living and in the purchasing power of teachers' average salaries during the current economic depression; (6) to compare the average salaries of teachers with the average incomes of other occupational groups . . .; and (7) to make suggestions for the improvement of the teachers' economic status with reference both to the management of personal income and to the determination of appropriate salary levels."

The report is too long and detailed to quote findings here. All teachers will be concerned with it as a matter of interest, although there may be little that they can do with it. Administrators should give the report careful study.

The data were taken from the reports of 37 cooperating city systems out of an original group of 51 selected cities. The findings hold only for teachers in these relatively favored localities. A great many teachers in small towns and in rural areas may be astonished at the sizes of incomes reported from these city situations. Perhaps the title of the bulletin should be changed to "The City Teacher's Economic Position." As it stands the title is misleading. —R.K.W.

Brown, William B. "What is Happening to the Curriculum of the Los Angeles Secondary Schools." *California Journal of Secondary Education* 10: 561–565; December, 1935.

The author lists the general trends in this summary apart from the development in the separate fields of learning: "1. A shifting of emphasis from learning, as a process of absorbing prearranged and prescribed subject-matter, into a much more active process, in which the pupil is an active participant in the planning and developing of each unit, as well as in the learning activities. 2. The fusion of compatible subject fields and materials, by removing some of the traditional department 'fences,' such as between English and social studies. 3. A greatly increasing emphasis on the adaptation of teaching to the individual differences of ability and interest. 4. An increasing informalization of teaching procedures, and unification of the learning activities of pupils. 5. Emphasis on subject matter only as means to more important ends, those latter relating mainly to personality and social growth. 6. The dethroning of the sacred 'single text' by placing more emphasis on the building up of classroom reference libraries. This includes the use of multiple sets of books, and the partial decentralization of the main library. 7. A growing realization that 'how to teach' cannot be considered as something apart from 'what to teach.' 8. Use of grades, primarily, as the balanced evaluation of the social and emotional, as well as the intellectual growth of the pupils—rather than the purely objective indication of the degree of mastery of subject-matter." —F.D.C.

Altstetter, Mabel F. "The Reading Interests and Experiences of 214 Teachers." *Peabody Journal of Education* 13: 80–84; September, 1935.

The reading habits and interests surveyed were those of English teachers. The problem presented is an exceedingly important one for all high-school teachers. Responses to the question, To what do you attribute your present interest in reading?, include: Books in my home and parents who loved books—56; Mother of relatives who read aloud—52; Parallel reading in high school—4; High school English teachers—11.

The reviewer was interested to note that not a single book on history, economics, politics, geography, travel, or science crept into the tabulated list of readings of these teachers. Perhaps English teachers consider only fiction as literature. All high-school teachers should read this brief study, ponder, and above all go back to the school situation with the intent to do something to influence the reading of their pupils.

It is interesting to note that Webb's annual review of science books occurs in the same issue of the magazine. —R.K.W.

Stallmann, Esther. "Picking Out Books for the High School Library—Some Principles." *Peabody Journal of Education* 13:132–136; November, 1935.

This article is made up of a definite set of numbered rules governing the selection of books for high school libraries. The suggested principles are classified under the following headings: prerequisites for the librarian selector; the selectors; general principles of selection; the format or physical make-up of the book; books for reference use; books for use in leisure time; periodicals, pamphlets, government documents; and censorship.

The suggestions will be found useful to school librarians, teachers, school administrators, and purchasing agents. The article is especially recommended for the reading of principals and superintendents, and those teachers on committees for the selection of library materials.

Not all readers will agree with the author's proposed censorship regulations. These are concrete and suggestive. It would be better for a school to have such a definite set of regulations than to try to operate with no standards of censorship.

—R.K.W.

SCIENCE EDUCATION

Schlesinger, H. I. "The Contribution of Laboratory Work to General Education." *Journal of Chemical Education* 12: 524–528; November, 1935.

The majority of science teachers seem to feel that the objectives of laboratory work are to supplement classroom instruction by clarifying and fixing facts and principles, to develop interest in science, and to teach something of laboratory methods. Much of our present-day questioning of the value of laboratory work is a result of the general acceptance of these objectives. It is reasonable to inquire whether they may not equally well be attained without laboratory work. The real objectives of laboratory work in science are, rather, training in observation, in clear thinking, and in the translation of observation and thought into well-considered action. At the University of Chicago an attempt is being made to organize laboratory work in introductory science courses so as to contribute to the attainment of these objectives. Laboratory exercises are being devsed and used which demand the solution of a simple problem by experimental means and the results of which cannot be predicated. By the use of such exercises it is hoped that the more fundamental purposes of laboratory work may be realized.

—V.H.N.

Osborne, R. W. "A Modified Program in Science." *North Central Association Quarterly.* 10: 359–364; January, 1936.

This article gives a description of the science program in the Francis Parker School, Chicago. The program includes general science in the seventh, eighth, and ninth grades; general biology in the tenth grade; and physical science in the eleventh grade.

The major portion of the article describes the last named course which centers around the comprehensive topic, "What is the Nature of Matter?" An extended outline of an illustrative unit is given.

The aim of the course is to "train pupils in the methods and habits of correct scientific thinking," not to learn items of information as such.

—A.W.H.

Frutchey, F. P., Tyler, R. W., and Hendricks, B. Clifford. "Measuring the Ability to Interpret Experimental Data." *Journal of Chemical Education* 13: 62–64; February, 1936.

Tests are being developed by means of which it is believed to be possible to measure a student's ability to classify various inferences based upon given experimental data as either reasonable interpretation, possibly true but insufficiently substantiated by the facts given, or untrue because contradicted by facts given. These tests give correlations ranging from .27 to .60 with other measures of achievement in chemistry which emphasize primarily a knowledge of facts and principles.

—V.H.N.

Le Vesconte, Amy. "A Plan for the Open House in Chemistry." *Journal of Chemical Education* 13: 72–73; February, 1936.

A description of an open house program given annually in Mary Hardin-Baylor, a girl's college. All students enrolled in chemistry take some part and the event is always a success. The program includes striking novelties and exhibits as well as demonstrations of more serious phases of chemistry.

—V.H.N.

Simons, J. H. "The Training Value of Chemistry in General Education." *Journal of Chemical Education* 12: 461–464; October, 1935.

The study of chemistry is an exceptionally good medium for training in observational skill, orderliness, ability to concentrate, creative imagination, manual dexterity and clear, accurate, analytical thinking. The study of chemistry also serves as general character training, discouraging falsehood, dishonesty, and developing stamina, and perseverance, cleanliness and neatness. In short, chemistry develops the mind and character as physical exercise develops the muscles. It is the unique task of the teacher of chemistry to bring about this valuable training process and chemistry is an ideal medium for it. However, only teachers thoroughly trained in the subject matter of chemistry can hope to accomplish these important purposes.

—V.H.N.

AYLEA, HUBERT N. "Bibliography for General Chemistry from Several Periodicals." *Journal of Chemical Education* 13: 76–81; February, 1936.

A bibliography of 138 titles. The articles are such as could be read by persons with little training in chemistry. Each reference is accompanied by a brief abstract, and the articles are classified as popular, chemical, or engineering. —V.H.N.

GLASOE, P. M. "A Chapter in Teaching Acids, Bases, and Salts." *Journal of Chemical Education* 13: 68–71; February, 1936.

Our textbooks in elementary chemistry are organized by chapters which are often unrelated to those immediately preceding or following. This makes for teaching which emphasizes memory rather than understanding. Such an important generalization of chemistry as acids, bases, and salts, is often found scattered through several different chapters of the textbook. The author of this article presents a plan for teaching this topic based on the arrangement of the elements in the second short series of the periodic table. It is the purpose of this plan to lead the student to arrive at an understanding of fundamental principles by reasoning and independent thinking beginning with facts they are already known to him. —V.H.N.

SAMPEY, JOHN R. "Developing a Professional Attitude in the Undergraduate Chemistry Student." *Journal of Chemical Education* 13: 20–22; January, 1936.

There are two chief avenues by which a professional attitude may be developed in undergraduate students of chemistry. These are (a) the instruction given in chemistry and (b) the attitude and standing of the instructor. Under (a) the author suggests placing chemistry majors in separate sections, insistence on professional points of view in classroom and laboratory work, and constant emphasis on accuracy and careful independent thinking. Under (b) are mentioned an active interest in and pursuit of research on the part of the instructor, membership in professional societies, and keeping contact with students after graduation. —V.H.N.

HARMAN, WARREN J. "Second-Year Chemistry for High-School Students." *Journal of Chemical Education* 13: 27; January, 1936.

To meet a demand for work in chemistry beyond the first-year course, a second year of chemistry was given in the Senior High School of Bend, Oregon. The students were a highly selected group, all having had chemistry for one year, and all well above average in ability and scholarship. The course included units on atomic and molecular weights, basic principles such as the kinetic theory, equilibrium, the periodic law with detailed study of groups of elements, carbon compounds, introduction to qualitative analysis and chemistry in industry. The course has proved highly successful as judged by increased demand for it. —V.H.N.

MANUEL, W. A. "How to Study Chemistry." *Journal of Chemical Education* 12: 579–580; December, 1935.

A brief discussion of the methods of study which make for success in chemistry courses. There are helpful suggestions and good advice here on efficient study, that will be applicable in any subject. —V.H.N.

MERWIN, BRUCE W. "Development of the Curriculum in College Chemistry." *Journal of Chemical Education* 12: 541–543; November, 1933.

A study of the offering in chemistry in the higher institutions of Kansas since 1855 shows marked and rapid growth. The total offering, as well as the number and variety of courses in chemistry has increased, especially since 1870. The courses seem to be developing mainly along three lines. First are those which aim to give technical and professional training, second, vocational and utilitarian courses, and third, general cultural courses in chemistry. —V.H.N.

SHEPPARD, ODEN E. "The Chemistry Student Still Needs a Reading Knowledge of German." *Journal of Chemical Education* 12: 472–473; October, 1933.

An analysis of 5410 literature citations in the *Journal of the Americal Chemical Society* for the year 1933 showed that 46.1% referred to articles in English, 38.8% to articles in German and 7.8% to articles in French, with smaller proportions in various other languages. In view of these facts it seems highly desirable, if not absolutely essential, for college students who major in chemistry to acquire a reading knowledge of chemical German. —V.H.N.

HUNT, HERSCHEL. "Demonstrations as a Substitute for Laboratory Practice in General Chemistry." *Journal of Chemical Education* 13: 29–31; January, 1936.

Laboratory manuals in chemistry, even though they bear a recent copyright date, are generally much the same in content and method as they have been for many years. Individual laboratory equipment of students is often poor and of little value. A capable instructor can demonstrate interesting significant experiments with a refinement of technique quite beyond the students' abilities and training. A carefully planned demonstration, well-performed, saves time and money, inspires interest, keeps the class together in experiments, reduces freshman mortality, and can be made part of a logically organized series of presentations which will greatly improve freshman courses in chemistry. —V.H.N.

ELDER, ALBERT L. "Applicability of the Lecture Demonstration Method to Certain Groups of Students." *Journal of Chemical Education* 13: 65–68; February, 1936.

A questionnaire sent to college chemistry teachers and industrial chemists revealed that 16% favored the elimination of individual laboratory experiments from introductory courses in chemistry while 84% did not. The author believes that before attempting to determine the relative merits of different methods of conducting laboratory work, it is necessary first to state objectives clearly, to devise measures of attainment of these objectives and to differentiate between students specializing in chemistry and others.
—V.H.N.

FARQUHAR, BRUCE S., AND RAY, FRANCIS EARL. "Proficiency of First-Year Students in Quantitative Experiments." *Journal of Chemical Education* 13: 74–75; February, 1936.

Instead of measuring the proficiency of students in laboratory work by tests of laboratory techniques or by instructors' works, the authors make distribution of the amount of error in the determinations of students as reported for quantitative experiments. The distribution curves presented in this article show a relatively high degree of accuracy. —V.H.N.

SCIENCE

BYRD, RICHARD EVELYN. "Exploring the Ice Age in Antarctica." *The National Geographic Magazine* 68: 399–474; October, 1935.

Admiral Byrd in this article describes his second trip to Little America. There are seventy-two illustrations and two maps. —C.M.P.

Symposium. "Astronomy." *Natural History.* 36: 186–265; October, 1935.

This special number of Natural History features the opening of the Hayden Planetarium of the American Museum of Natural History. The entire number is very interesting and includes some of the finest photographs to be found in any astronomy source material. Special articles describe the Hayden Planetarium and its construction. Additional articles are: Frank C. Jordon—Astronomical Fiction; Clyde Fisher—The Birth of the Solar System; Marian Lockwood—Ancient Man and His Universe; Clyde Fisher—Glimpses into Relativity; Frederick Slocum—The Calendar Through the Ages; W. F. G. Swan—Cosmic Rays; and Dorothy A. Bennett—The Mysterious Moon. —C.M.P.

Anonymous. "Electroplating Leather, Wood, Plaster and Other Non-Conductors." *Popular Mechanics* 65: 146–151; January, 1936.

The title gives the scope of this article. Methods of applying conducting coatings to such materials as baby's shoe, a butterfly, flowers, fruit, and small statuary and models are given, and details of plating solutions and current densities for copper and silver plating.
—O. E. Underhill.

SY, A. P. *"Alchemy." Journal of Chemical Education* 12: 303–308; July, 1935.

The alchemists were, for the most part, interested in one of three problems. These were, transmutation of base metals into gold, discovery of the elixir of life which would cure all ills and prolong life, and the explanation and understanding of Deity through the "science" of alchemy. The work of the alchemists, although scarcely creditable from the point of view of modern chemistry, was the forerunner of the chemistry of today. —V.H.N.

Symposium. "Progress of Science." *Science News Letter* 28: 388–391; 394–398; December, 1935.

This is the annual summary of the outstanding achievements in science during 1935.
—C.M.P.

TALBERT, ANSEL E. "Will Uncle Sam's Gas Tank Run Dry." *Science News Letter* 28: 234–236; October 12, 1935.

The United States is using twice as much petroleum as drinking water and the problem of a future source of supply is a vital one. The article discusses possible secondary supplies and substitutes. —C.M.P.

Anonymous. "Scientists to Advise Nation." *Science News Letter* 28: 374–375; December 14, 1935.

President Roosevelt's Science Advisory Board expired on December 1, but a new body has been formed for which a research fund of $3,500,000 is proposed. The article describes some of the proposed activities of this new scientific research body. —C.M.P.

BREASTED, JAMES HENRY. "The Beginnings of Time-Measurement and the Origins of Our Calendar." *The Scientific Monthly* 41: 289–304; October, 1935.

The author traces the origin of the calendar and the beginnings of time measurement. The article discusses continuous and discontinuous time and the reasons for having a 365 day year and a twenty-four hour day. —C.M.P.

Anonymous. "New Pressures Make Ice Hotter than Boiling Water." *Science News Letter* 28: 355–356; December 7, 1935.

The article describes the experiments with high pressures carried out by Prof. Percy W. Bridgman at Harvard University. Pressures duplicating those inside the earth have been used, pressures up to 70,000–100,000 atmospheres. Seven kinds of ice have been formed, one with a temperature hotter than boiling water. Pressure brings about many changes in substances. Many

polymorphic changes have been made in elements by subjecting them to high pressures.

—C.M.P.

Thone, Frank. "No More Straight Furrows." *Science News Letter* 28: 364–366; December 7, 1935.

Soil conservationists are teaching the farmer to break with an age-old tradition—the straight furrow, the former token of every self-respecting farmer's great pride in his craftsmanship. A crooked furrow was considered a weakness—even a sin at one time, but now the farmer is becoming erosion-conscious and experience is showing that curving furrows is one of the best ways of preventing erosion. Furrows now follow contour lines. —C.M.P.

Harrington, Jean. "Building Blocks of the Atom." *Scientific American* 153; 176; October, 1935.

Brief discussion of the terms scientists use in connection with the atom: electron, proton, positron, neutron, alpha particles, neutrino, deuteron, and photon. —C.M.P.

Aaron, S. F. "Nature Faking Again." *Scientific American* 153: 186–187; October, 1935.

In an article that every science teacher and writer of biological topics should read, the author severely takes to task the "nature experts and others" who often write so much that is not so.

—C.M.P.

Condon, E. U. "Energy from Matter." *Scientific American* 153: 300–301; 339–340; December, 1935.

Thirty years ago Einstein announced the principle that mass and energy are equivalent. As yet there is no recorded instance in which the whole mass of an atom was converted into energy of motion or of radiation. However, we do have evidence of mass-energy conversion in the energy changes involved in the atomic transformations studied in nuclear physics. The author describes experiments verifying Einstein's Principle in which stupendous energy is revealed, but is unavailable because of low efficiency of transmutation. —C.M.P.

Nieuwland, J. A. "Synthetic Rubber from Gas." *Scientific American* 153: 262-263; November, 1935.

The author of this article, Father Nieuwland of Notre Dame University, has been awarded the gold medal of The American Institute and the Nichols Medal of the American Chemical Society for his discovery of Duprene or synthetic rubber. The author presents a brief history of the production of Duprene from acetylene gas. Some of the ways in which Duprene is superior to ordinary rubber are listed.

—C.M.P.

Bowie, William. "The Origin of Continents and Oceans." *The Scientific Monthly* 41: 444–449; November, 1935.

The author explains that no hypothesis satisfactorily accounting for the origin of continents and oceans has been advanced. In this article he presents evidence that the most satisfactory hypothesis is the one advanced by Darwin and supplemented by Fisher—that of the disruption of the crustal surface of the earth by the tidal attraction of the sun. This would satisfactorily account for the origin of the moon.

—C.M.P.

Smith, Philip H. "Not Just Glass." *Scientific American* 153: 314–317; December, 1935.

Glass is at least 6,000 years old but little progress, aside from advances in the technique of making art objects, was made until twenty years ago. The illustrated article describes new important uses of glass in architecture. industry and science. —C.M.P.

Waitt, Alden H. "No Super War Gas." *Scientific American* 153: 293–297; December, 1935.

No ideal war gas has been found nor, in the opinion of the author, is it ever likely to be found. War gas must not only have toxic or irritant properties sufficient to cause casualities or disable in extremely low concentrations, but it must possess also suitable physical and chemical characteristics, and meet rigid economic standards. No known gas ideally meets these requirements and only ten or fifteen can be used satisfactorily on a large scale. Each of the above points is discussed at some length by the author.

—C.M.P.

Wetmore, Alexander. "Birds of the Northern Seas." *The National Geographic Magazine* 69: 95–122; January, 1936.

This is the twelfth in a series of articles on the bird families of North America. Birds described in this series include the auks, murres and puffins. There are thirty-four paintings from life by Maj. Allan Brooks. —C.M.P.

New publications

POWERS, SAMUEL R., NEUNER, ELSIE F., AND BRUNER, HERBERT B. *Directed Activities I.* Boston: Ginn and Company, 1935. 113 p. $0.40.

This is a workbook to guide pupils in their study of *The World Around Us,* the first book in the survey of science series written for junior high schools by the same authors. The book is divided into eight units each containing exercises and experiments suitable for boys and girls of junior-high-school age.

The experiments and projects have been carefully selected and organized. Diagrams show the set-up at the beginning of the experiments. Space is provided for conclusions at the end of each problem. Self-testing exercises are included which provide a means by which the student may check his own progress.

—Elwood D. Heiss.

POWERS, S. R., NEUNER, E. F., AND BRUNER, H. B. *Man's Control of His Environment.* Boston: Ginn and Company, 1935. 753 p. $1.60.

This is the third book of the series *A Survey of Science.* The book deals primarily with man's control and use of energy in a changing environment. Man through his knowledge of scientific principles has learned to control living organisms, the production of food, and the use of natural forces in everyday devices. These scientific interpretations are admirably treated. The authors include, as an integral part of the text, the social implications of the scientific generalizations which present-day courses should offer as a significant part of science education.

Opportunity has been afforded to the reviewer to use the book in several science classes. The responses have been noteworthy in that students find considerable scientific data which are applicable to their individual problems. There are, however, phrases and paragraphs which must be interpreted for them by teaching specific mathematical concepts and much illustrative material from which students can adequately generalize or comprehend the generalizations in the book. The phrase "the uniform pull of gravity uniformly accelerates the velocity of fall" is an example of the above situation. However, in using any book, the teacher must be cognizant of such learning difficulties and modify the learning experiences so that the material becomes intelligible to the reader.

The text is well illustrated; new and different pictures and diagrams appear which are illustrative of the factual material. The chapters are followed by summary statements or generalizations, questions for review and discussion and suggestions for additional learning situations.

The book lacks numerous learning procedures which will train the student specifically in the acquirement of scientific attitudes and in the elements of problem solving. If the teacher is conscious and critical of these more important objectives of science education, much material in the book can be modified and adapted for this purpose.

The reviewer recommends this text, as well as the entire series, as being highly desirable for the science instruction in the junior high school.

—Edith M. Selberg.

NOLL, VICTOR H. *What Do You Think?* (Forms 1 and 2). New York: Bureau of Publications, Teachers College, Columbia University, 1935. $0.40.

In recent years much attention has been focused in secondary-school-science on the teaching of scientific attitudes and the consequent measurement of them. This test is one of the first, if not the first, that purports to measure this more or less elusive characteristic or attitude. Dr. Noll is to be commended in making this initial test. The test is based on the following six habits of thinking: accuracy, suspended judgment, open-mindedness, intellectual honesty, criticalness, and the habit of looking for true cause and effect relationships. A teacher's manual gives a brief description of the derivation of the test and its use, a discussion of the habit of scientific thinking and how it may be taught.

The items of the test are mainly of the true-false type, with a few multiple-choice type. Tentative norms are given. Some of the items may be open to question, but that is true of most tests and more especially those tests venturing into more or less new fields.

—C.M.P.

LUMLEY, ELLSWORTH D. *Eagles; Hawks.* (Two Units). New York: Emergency Conservation Committee, 1935. 10 p. each. $0.10 each.

These are two units in a series of teaching units on bird conservation. Each unit gives a brief description of the species, its habitat, the truth regarding its exaggerated destructiveness, and the need of conservated effort, if the species is to survive. Suggested assignments are a part of each

unit. The units are recommended for class use in biology or general science. —C.M.P.

Vinal, William Gould. *Nature Education: A Selected Bibliography.* Cleveland: Curriculum Laboratory, Western Reserve University, 1934. 82 p. $0.75.

This is a selected bibliography in nature education listing 1988 titles under nine main headings. Elementary science and nature study teachers will find this a most complete and useful bibliography. —C.M.P.

Schwartz, Julius (Chairman). *Adventures in Biology.* Brooklyn: New York Association of Biology Teachers (Thomas Jefferson High School), 1934. 59 p. $0.50.

This compilation of 286 projects in biology was by members of the New York Association of Biology Teachers. Projects are listed in ten groupings. A bibliography containing 680 titles is appended. Brief description of each project is given, together with cited references. This is an excellent and practical book for all biology and general science teachers. —C.M.P.

Downing, M. M., and Bradbury, G. M. *Problems and Experiments in Chemistry for Girls.* Montclair, N. J.: G. M. Bradbury, Montclair High School, 1934. 169 p.

Textbooks and laboratory manuals in chemistry for girls, without exception, place a more than usual emphasis upon the practical aspects of chemistry, especially that relating to chemistry of the home. This manual is no exception. The reviewer is in agreement with this practice and believes it should be the standard of general chemistry textbooks and laboratory manuals. Each experiment is set up as a problem, with usually introductory statements of pertinent information relating to the problem. The units on cosmetics and textiles are quite interesting. —C.M.P.

Tyler, Ralph W. *Service Studies in Higher Education.* Columbus, Ohio: Bureau of Educational Research, Ohio State University, 1932. 283 p. $2.00.

This volume describes service studies conducted by various staff members of Ohio State University, where, within recent years, probably the most significant research studies at the college level are being carried out. A major portion of these studies have been in the various science divisions, but notably botany and zoology. Such service studies offer the most promising means of improving the classroom work of colleges and universities.

The pertinent chapters for science teachers are: "The methods followed in the teaching of general botany"; "The construction of examinations in botany and zoology"; "Reorganization of the elementary courses in zoology"; "Special treatment for superior students in general zoology"; "An experiment in sectioning students in the second course in zoology"; "Remedial instruction for students having difficulty in zoology"; "Certain administrative procedures in zoology and botany." Supplementary material in each of the fields of botany and zoology are found in the appendixes. —C.M.P.

Wrinkle, William L., and Armentrout, Winfield D. *Directed Observation and Teaching in Secondary Schools.* New York: The Macmillan Company, 1932. 399 p. $2.50.

The authors attempt to develop a course in directed observation and teaching which will bridge the gap between the college classroom in educational theory and principles, and the secondary classroom. The learning technique employed are: (1) Problems; (2) Educational terms; (3) Directed study tests; (4) Directed observations; and (5) Supplementary readings.

The nature of this excellent guide may best be gained from the titles of the chapter headings: "The professional preparation of teachers"; "Classroom management"; "The student"; "Aims and objectives in teaching"; "The assignment"; "Motivation"; "Directing learning activity"; "The question"; "Methods of teaching"; "Providing for individual differences"; "Testing"; "Planning"; "Discipline"; "Records and reports"; and "The evaluation of teaching". —C.M.P.

Tyler, Ralph W. *Constructing Achievement Tests.* Columbus, Ohio: Bureau of Educational Research, The Ohio State University, 1934. 110 p. $1.25.

This monograph is a reprint of a series of articles which have appeared in The Educational Research Bulletin at various times during the period 1930–34. It supplements the monograph reviewed above—Service Studies in Higher Education. The following theses are considered: "Measuring the results of college instruction"; "A generalized technique for constructing achievement tests"; "Formulating objectives for tests"; "Ability to use scientific method"; "Measuring the ability to infer"; "A test of skill in using a microscope"; "The master-list as a device"; "Improving test materials in the social studies"; "Assumptions involved in achievement test construction"; "What is statistical significance"; "Making a cooperative test service effective"; "Permanence of learning"; "Certain administrative procedures in botany and zoology"; "Techniques for evaluating behavior"; and "Evaluation: A challenge to secondary education".

The generalized technique of constructing an achievement test in concretely described as it has been applied to the field of zoology. The first step is formulating the course objectives, of which there are, in zoology, eight types: "Information which includes terminology, specific facts and general principles"; "Reasoning or scientific method, which includes induction, testing hypotheses, and deduction"; "Location of relevant data"; "Skills of particular subjects"; "Standards of technical performance"; "Reports—skill in reporting"; "Consistency in application of point of view"; "Char-

acter, which is perhaps most inclusive, involving many specific factors".

The second step is to define each objective in terms of student behavior. The third step is to collect samples of specific situations which belong to each type. The fourth step is presenting the situation to the students which is primarily the function of the test constructor. The fifth step is evaluating the student reactions in the light of each objective.

The theses relating to ability to use the scientific method, measuring the ability to infer, what is statistical significance, permanence of learning, and techniques for evaluating behavior, are especially commendable and significant. —C.M.P.

REMMERS, H. H. (Editor). *Studies in Attitudes.* LaFayette, Ind.: Division of Educational Reference, Purdue University, 1934. 112 p. $1.25.

In recent years educators have come to realize more and more the importance of measuring attitudes. The more or less intangible nature of attitudes, involving as they do so many complex relationships, has frustrated most attempts to measure them at all satisfactorily. A slight beginning has been made, but it is the writer's opinion that this beginning is very slight indeed.

Professor Remmers of Purdue University, well-scale for college teaching efficiency, has also made known in connection with the Purdue rating notable contributions to the measuring of attitudes.

This monograph reports some of the studies that have been conducted at Purdue University. The following studies are reported: (1) Generalized attitude scales—studies in social-psychological measurements; (2) The construction and evaluation of a scale to measure: (a) attitude toward any institution, (b) attitudes toward defined groups (c) attitude toward any home-making activity; (d) attitude toward any practice; (e) attitude toward occupation; (f) attitudes toward vocations; (g) attitude toward any school subject; (3) The relationship between attitudes toward school subjects and certain other variables; and (4) the validation of a generalized attitudes scaling technique—an attitude scale toward teaching.

To illustrate the general technique of measuring various attitudes, the one of attitude toward teaching will be used. This scale consists of two forms of 45 items each, each of the items having a determined scale value ranging from 10.7 for the highest item to 1.3 for the lowest item. In taking a test, the participant checks each item with which he agrees regarding the teaching profession, the items being arranged in order from the most favorable. The two highest, the two median, and the two lowest items follow: (1) To strive to teach well is to pattern after Christ, who was the Master Teacher. There can be no higher calling. (2) Teaching is one of the most necessary of the professions. (3) Teachers should not be taken too seriously. (4) Students would learn more if the teachers followed the textbook more closely. (5) Teaching leads to insanity more often than other kinds of work. (6) Teachers are parasites.

—C.M.P.

RAMSEY, GRACE FISHER. *Project Making in Elementary Science.* New York: American Museum of Natural History, 1934. 25 p.

This useful pamphlet describes in some detail a few projects that are suitable in elementary science. Projects described include: (1) Habitat groups—insects, birds, social cultures: (2) Dwellings; (3) Seashore projects; (4) Rock and mineral project; (5) Protozoa—Chordata, Railroad project; (6) Balanced aquarium; (7) Terrarium; (8) Electrical charts; and (9) Science principles.

—C.M.P.

ROBBINS, WILFRED W., AND ISENBARGER, JEROME. *Practical Problems in Botany.* New York: John Wiley and Sons, Inc., 1936. 402 p. $2.00.

This is first botany for secondary schools to appear in recent years. In comparison with older textbooks in botany, it is somewhat a departure. It is more in keeping with the modern trends of secondary textbooks in science and is organized on the basis of problems. However the authors did not go the whole way and use the organization and learning techniques found in present day biologies. If they had done so, it would have resulted in a most significant contribution to secondary biological science. However the authors have to some extent broken away from the traditional type of organization. The book will prove to be an excellent supplementary book for secondary science and should be welcomed by all schools offering courses in botany.

Principles have been emphasized rather than isolated facts. The introduction of the book is an overview of the entire course, and the introduction of each unit is an overview of that unit. One of the most useful features of the book is the introduction of exercises for laboratory and home work—totalling 144 in number.

The following ten units constitute the course: (1) The organization and composition of plants; (2) The nutrition of green plant; (3) Nutrition of non-green plants; (4) Growth of plants; (5) Reproduction of plants; (6) The dependence of plants on the conditions of their surrounding; (7) How plants are fitted to the conditions of their surroundings; (8) The development and improvement of plants; (9) The classification of plants; (10) The economic importance of plants to man.

—C.M.P.

OLSON, OVE S. *Methods of Teaching High School Biology—A Syllabus.* Minneapolis: Burgess Publishing Company, 1934. 68 p. $1.25.

The syllabus is intended for use by a student who wishes professional training in the teaching of biology. It covers the topics pertaining to the objectives of biology, the underlying psychology,

methods for teaching, required equipment, lesson planning and the desired preparation for a biology teacher. Certain knowledges are included which are of specific concern to the teachers of biology in the state of Minnesota. The outlined course is commendable in that it covers many of the fundamental aspects of teaching, includes differentiated assignments in terms of minimum and supplementary exercises and the assignment or the guide for learning is organized in the form of questions and activities necessary for the guidance of thought and the association of ideas.

The guide may be improved by the inclusion of the more progressive viewpoints in science teaching and the research data which is available. It fails to emphasize sufficiently the pupil learning skills and techniques which are mandatory under the present educational philosophy.

—Edith M. Selberg.

Miller, George J. (Editor). *Geography How to Teach It.* Bloomington, Illinois: McKnight and McKnight, 1934. 188 p. $1.60.

The contributions of this volume have been prepared by twenty-four teachers of geography and represent a reprint of articles on methods of teaching geography which have appeared in the *Journal of Geography* from time to time. Inasmuch as the articles are the product of classroom experience they are indicative of ways and means of working out problems in geography.

The following are sectional titles: "Organizing geographical materials"; "Geography exhibits"; "Maps, pictures and other aids"; "Geography field work"; "The assembly program"; "Mathematical geography"; "Teaching climate"; and "Unit studies." Many of the illustrative units are taken from the science field. —C.M.P.

Heil, L. M. *The Physical World.* Philadelphia: P. Blakiston's Son and Company, Inc., 1936. 566 p. $2.75.

This book is an excellent addition to the few texts now available for a first year college text in "cultural" physical science. It does not entirely ignore the mathematical side of science, but the emphasis is upon interpreting the physical world; in explaining the "hows" and "wherefores." The subject matter is for the most part physics, but out of the eleven units one is on the subject of astronomy, one on chemistry, and one on x-rays and radioactivity which combines physics and chemistry. The book has unusual attraction and the cloth binding is "water resisting and vermin proof." —W.G.W.

Crew, Henry. *The Rise of Modern Physics.* Baltimore, Md.: The Williams and Wilkins Company, 1935. 434 p. $4.00.

In the preface to this second edition of his earlier book the author makes the following definition and explanation: "I am now using the word *modern* in the same sense in which historians usually employ it; namely, to cover the period subsequent to the renaissance. In science this means the period since the time of Galileo, or roughly, the last three centuries." The completion of the ideals set forth in the above quotation the author has admirably carried out his plan. The entire book is filled with well-selected material and a definite plan has been followed in carrying out his aims.

The book contains brief historical sketches of the Greek and Roman science, the physics of the Arabians and the physics of the Middle Ages. He then traces out the stages of progress in modern physics, selecting those researches and theories which have had a very definite bearing upon our present trends in physics. In all of these developments a good deal of the more mathematical phases of the various workers in their respective fields has been omitted but this is perfectly logical in view of the fact that the author states: "In the preparation of these pages, the one individual who has been constantly before my mind is the undergraduate just entering upon the study of advanced physics."

This book will serve as a source book in physics and might well be used for reference work as well as a text in the history of physics. All the material seems to be authoritative and can be relied upon.

Fred L. Herman.

Lackey, Earl E. *Introductory Geography for Teachers College Students.* Lincoln, Nebraska: Earl E. Lackey, The University of Nebraska, 1933. 124 p.

This doctoral dissertation develops a technique for selecting and evaluating materials for a professional subject-matter treatment of the introductory geography course. After setting up certain criteria for evaluating geographic subject matter in the form of questions, the author determined the relative importance and the possibilities of illustrating the materials out-of-doors in the home area. The following criteria were used: (1) The criterion of human interests and activities; (2) The criterion of natural environmental conditions; (3) The criterion of relationships or interactions; (4) The criterion of local applicability; (5) The criterion of outside applicability; (6) The criterion of crucial present-day problems; (7) The criterion of possible utilization for professional subject matter in a course for teachers' college students.

Altogether the thesis represents a very commendable piece of work and the techniques employed in this study would seem to have possible applications to the science field. —C.M.P.

English, George Letchworth. *Getting Acquainted With Minerals.* New York: McGraw Hill Book Company, 1935. 324 p. $2.50.

This is the best guide book on the identification of minerals that the reviewer has read or used. The work is accurate, comprehensive, readable, and excellently illustrated. This is a book for the beginner in mineral study and is recommended for

school libraries, to all elementary and secondary science teachers and to others interested in becoming acquainted with minerals and rocks. The book can be read and understood by anyone, so simply and interestingly is it written, yet without sacrifice of scientific accuracy. The 258 illustrations add much to the usefulness of the book and each has been selected on the basis of its pertinency. Those desiring a good book on rocks and minerals and their identification cannot go wrong in obtaining this book. —C.M.P.

Peattie, Donald Culross. *Trees You Want to Know*. Racine, Wis.: Whitman Publishing Company, 1934. 95 p. $0.10.

This vest-pocket-size key gives a brief description of the more common trees. A photograph of the leaves and fruit accompanies each description. The key will be most useful to biology and elementary science teachers and pupils. —C.M.P.

Harvey, Jane. *Wild Flowers of America*. Racine, Wis.: Whitman Publishing Company, 1932. 96 p. $0.10.

This is a most convenient vest-pocket-size key to the more common wild flowers of North America. Brief descriptions of each flower, its habitat, and blooming period, together with a colored photograph, make the key most useful for pupils and teachers. —C.M.P.

King, Julius *Wild Flowers at a Glance*. Cleveland, Ohio: The Harter Publishing Company, 1935. 63 p. $0.10.

This pocket-sized key with the colored photograph of the flower, its leaves, fruit, and habitat, tells you at a glance the name of the flower, where it grows, when it blooms, and its common and scientific name. It is a key you will enjoy looking through and using.

King, Julius. *Talking Leaves*. Cleveland, Ohio: The Harter Publishing Company, 1934. 62 p. $0.10.

In this pocket-sized key, fifty-nine of our most common trees are described. The key gives a brief description of each tree, its leaves, fruit, general shape of the tree, height, habitat (pictured on a map), common name and scientific name. Photographs of the leaves, fruit and flower, arranged against a background of squares, makes possible a direct comparison with the size of the specimens under observation.
—C.M.P.

Zodac, Peter. *How to Collect Minerals*. Peekskill, New York: Rocks and Minerals, 1934. 80 p. $1.00.

The author is editor of the journal, *Rocks and Minerals*, and has had the rich experience of many years as a mining engineer, prospector, mineral dealer and collector. This authoritative bulletin has been written especially for the amateur in mineral collecting and as such should have wide appeal to elementary science and secondary science teachers.

The following points are discussed at some length: "How to Begin"; "Hints on Collecting"; "What to Collect"; "Cleaning, Trimming, Preserving, Displaying, and Identifying Minerals"; and "Miscellaneous." An excellent bibliography is included. —C.M.P.

Rosevear, Francis Burt. *The Science Craft Mineralogy Manual*. Hagerstown, Md.: The Porter Chemical Company, 1935. 143 p.

This experimental manual discusses: (1) Geology; (2) Chemistry; (3) Crystallography; (4) Physical properties; (5) Blowpipe and chemical tests; (6) Descriptive mineralogy; (7) Gems; (8) Making your mineral collection; and (9) The determination of minerals and rocks. One hundred twenty-eight experiments are described. Each important mineral is described as to source, properties, distinguishing features, uses, and experimental tests for identifying. This is a useful manual even for those not especially interested in chemically identifying minerals. —C.M.P.

Muenscher, W. C. *Weeds*. New York: The Macmillan Company, 1935.

This is a book that would seem to serve a widefelt need. There have been very few books on the identification of weeds and their economic importance, distribution, and control. Although the treatise is limited to weeds of the northern United States, it will be found useful for all parts of the United States, as many weeds are common to every section.

Part I discusses weeds and their control as follows: "Dissemination and importance of weeds"; "Weeds of special habitats"; "The control of weeds"; and, "Chemical weed control." Part II comprises a key for the identification of weeds, and a detailed description of each family. This family description includes the scientific and common name of the family, the scientific and common names of the more important individuals of the family, a description of each individual weed and methods of reproduction, habitat and control. Many illustrations are included. Five hundred weeds are described and identified. Every teacher desiring a key and description for the identifying of weeds will find this the best guide now probably available. —C.M.P.

Blakeslee, Albert Francis, and Jarvis, Chester Deacon. *Trees in Winter*. New York: The Macmillan Company, 1931. 292 p. $2.00.

Trees in Winter is a handbook for identification of trees that should have wide appeal to the many science teachers who feel the need of a *winter tree* guide. There are so many tree guides for other times of the year and many teachers often feel that "trees look so different in the winter time." Here is a book that many have been looking for. Really trees may be more easily identified in the

winter time, if one knows what to look for. The identification keys, descriptions and photograps enable even those not trained in botany, to gain facility and satisfaction in identifying common trees. Chapters on explanation of terms and how to use the key and a glossary add much to the usefulness of the handbook. Each tree is described as to habit, bark, twigs, leaf-scars, buds, fruits, comparisons, distribution, and wood. —C.M.P.

WERTHNER, WILLIAM B. *Some American Trees.* New York: The Macmillan Company, 1935. 398 p. $5.00.

The author, who died before the book was sent to press, was an authority on trees. In this book he presents an intimate study of native Ohio trees. To him only God could make a tree! This love of trees is evident in his descriptions of the favorite trees of his boyhood. There are three hundred excellent photographs that aid materially in helping to identify the trees. His "earmarks" of each species of tree includes the one or more unvarying characteristics by which the species may be easily identified. The book is written in an interesting style which, together with the many little intimate details, makes it a tree guide and reference that should appeal to elementary and secondary science teachers, and to secondary school pupils. —C.M.P.

Anonymous. *An Elementary Course in Photography.* 1936. 44 p.; *Darkroom Plans.* 1936. 8 p.; *Lantern Slides: How to Make and Color Them.* 34 p. Rochester, New York: Eastman Kodak Company.

An Elementary Course in Photography is a series of thirty mimeographed lessons in the art of learning to make pictures. Each lesson is outlined as follows: purpose, equipment, and procedure. Science teachers interested in photography will find this a most useful outline.

Darkroom Plans describes the equipment needed in the darkroom and methods for making much of it home-made.

Lantern Slides: How to Make and Color Them devotes a section to each of the two phases indicated in the title. This practical guide is recommended to all science teachers interested in making or coloring slides. —C.M.P.

Symposium: *Courses of Study in Science for Senior High Schools.* Bulletin 74. Harrisburg, Pa.: Department of Public Instruction. 110 p.

Courses of study in biology, chemistry, and physics, for use in the state of Pennsylvania, outlined in this bulletin, were prepared under the direction of three committees. As a whole the respective courses of study represent a creditable piece of work, favorably comparable to that of other more recent city and state courses of study. In the chemistry course of study, there is one unit, with the placement of which the reviewer radically disagrees. Unit seven, the last unit, is on matter and electronic structure, including the writing of equations and formulae. If this is an essential unit at all, it should be placed much earlier in the course. And it is difficult for the reviewer to agree that much real understanding of chemistry can be had without a good conception of the electronic structure of matter, and the ability to write common equations and formulae. Certainly, difficulty in teaching cannot explain its being placed last, although the foreword does say the units might be varied as to their order, depending on local conditions. —C.M.P.

SECRIST, MARK HOWARD. *Laboratory Manual for General Geology.* New York: The Macmillan Company, 1935. 295 p. $1.75.

This manual covers both physical and historical geology and is designed to accompany any general text in geology. Fundamental principles are emphasized and each lesson makes a complete unit of study. The maps, illustrations, diagrams, and tables are excellent. The block diagrams are especially good. The reviewer is convinced that this is a much better manual than the one he used as a student a few years ago. Its actual use in the laboratory would assure an excellent course in laboratory geology. —C.M.P.

Symposium: *Popular Science Talks.* Philadelphia: The Philadelphia College of Pharmacy and Science, 1933, 1934. Volume XI, 222 p.; Volume XII, 198 p. $1.00 each.

Several volumes of this interesting series were reviewed in the October, 1935, issue of SCIENCE EDUCATION. Volume XI contains a series of popular lectures on nine topics; Volume XII covers eight topics. Each lecture is by an outstanding authority in the field. The reviewer has found most of the lectures interesting to read and often quite practicable as material for classroom teaching. —C.M.P.

PATCH, EDITH MARION. *Holiday Meadow.* New York: The Macmillan Company, 1935. 165 p. $2.00.

This is another collection of splendid nature stories written in simple and informative style about a pleasant field "full of puzzles." "The more answers you can find by hunting and watching the better you will enjoy your holiday in a meadow." So begins the stories of the habits and behavior of the birds, animals, insects who live in the meadow, some of which are: the meadowlark, Daucus; a member of the Parsley family; the only family of plants upon which the Black Swallowtail butterflies lay eggs; the Woodchuck or Marmot; the Star-nose mole, who liked cutworms; and Ctenucha, the caterpillar who has many adventures in her life. The illustrations add much to the attractiveness of the book.

—June M. Common.

PATCH, EDITH MARION. *Holiday Pond.* New York: The Macmillan Company, 1935. 147 p. $2.00.

Nature study material is presented in a very

interesting and excellent manner in the ten delightful stories about the frogs, fishes, turtles, animals and birds who inhabit Holiday Pond, or live nearby and of the plants which grow about it.

The stories are suitable for third and fourth grades and the illustrations which are partly photographs and pen drawings make the material very readable and informative.

—June M. Common.

KOEPPE, CLARENCE E. *Earth and Sun Relations.* Bloomington, Ill.: McKnight and McKnight, 1934, 55 p. $0.20.

This practical book for geography and general science teachers discusses the following topics: (1) The form and size of the earth; (2) Rotation of the earth; (3) Directions on the earth; (4) The earth and the solar system; (5) The seasons; (6) Determination of latitude, longitude, and time; (7) The calendar; and (8) The earth and moon.

—C.M.P.

FREEMEN, OTIS W. *Story of the Hawaiian Islands.* Bloomington, Ill.: McKnight and McKnight, 1935. 68 p. $0.24.

Geography teachers will find this a most interesting and quite complete teaching unit on the Hawaiian Islands—their climate, forests, people, history, and industries. —C.M.P.

RIDGLEY, DOUGLAS C. *Journeys Around the World.* Bloomington, Ill.: McKnight and McKnight, 1935. 48 p. $0.20.

Journeys Around the World is an imaginary trip around the world about the fortieth parallel. The author made a similar real trip around the world as a teacher of geography on the First College Cruise Around the World. Some of the more recent around-the-world aeroplane flights are also the basis of briefly described world journeys. —C.M.P.

ATWOOD, WALLACE W., THOMAS, HELEN GOSS, AND COLLAMORE, EDNA A. *Workbook in Geography* to accompany *Home Life in Far-Away Lands.* Boston: Ginn and Company, 1934. 96 p. $0.24.

This workbook to accompany the excellent Atwood and Thomas' *Home Life in Far-Away Lands* will prove very practical to teachers of geography. Elementary science teachers can find some helpful information and exercises in this geography workbook and others similar to it. —C.M.P.

RIDGLEY, DOUGLAS C., AND RUSSELL, H. HARRISON. *Junior High School Geography.* Bloomington, Ill.: McKnight and McKnight, 1934. 160 p. $0.72.

This is a text-workbook for a full year's work in geography in the junior-high-school. An attempt has been made to avoid a repetition of lower grade material and emphasis has been made on research, observation, field trips, and reports. The use of supplementary reading material and the interpretation of charts and graphs is emphasized. A series of ten tests have been prepared to accompany the text-workbook. —C.M.P.

AMES, MAURIEE U., AND JAFFE, BERNARD. *Laboratory and Workbook Units in Chemistry.* New York: Silver, Burdett and Company, 1935. 228 p. $0.84.

This chemistry workbook contains fifty-one units designed to meet the needs of a complete course in elementary chemistry. The exercises are based upon the suggestions and requirements of state and college-entrance syllabi, on standard textbooks and on the authors' experiences as teachers of elementary chemistry.

Each unit begins with experiments. The experiments are followed by observations and questions, on the experiments. Supplementary exercises follow. Optional questions of the essay type are given at the close of each unit.

—Elwood D. Heiss.

MEDSGER, OLIVER PERRY. *Nature Rambles. Spring.* New York: Frederick Warne and Company, Inc., 1931. 160 p. $2.00. *Winter* 1932. 160 p. $2.00.

These are two books of a series of four devoted to seasonal nature rambles in which the author takes the reader with him into the woods, along the roadside, by the brookside, to the pond, through field and orchard, describing and interpreting the forms of plant and animal life found in these various places. Mr. Medsger is a real nature lover, and has put in a lifetime of keen observation and enthusiasm which animate his writings throughout. The language is non-technical, Latin names having been omitted except where necessary.

The reader infers that most of the material in *Spring* refers to the northeastern part of the United States. The rather general nature of the material makes it broad in scope but less useful as a handbook for any particular locality. In *Winter* are given chapters on "California" and "Florida" which are specific in nature and very helpful in their descriptions of native life in these two regions which are much frequented by people from other states. The author's personal experiences enliven both books.

Although the style is simple and chatty, there are errors in sentence and work construction in both books. There is a slight touch of personification in the use of pronouns in referring to animals.

The value of the many fine illustrations would be enhanced by arranging them closer to the next references. Plate 4 in *Spring* seems to be reversed.

An index makes the books usable for reference. The set might well be on the reference shelves of school libraries. The adult lay reader will find the books enjoyable.

—Lois M. Shoemaker.

Sullivan, J. W. N. *Science: A New Outline.* New York: Thomas Nelson and Sons, 1935. 279 p. $2.00.

Written as a survey of modern science understandable by the reader who has not a background of science and mathematics, this brief exposition presents, in an illuminating and challenging fashion, the newer concepts ranging from the structure of the atom and the universe to the evolution of life on the earth.

The selection of what is significant in modern science is made subjectively and many readers naturally will not agree with the author's choice of content though they must agree that what is written is up-to-date and most stimulating in its graphic literary style.

A few hours with this survey will give the person with a science background a pleasing and a helpful overview of some of the newer discoveries in the field of science. The teacher of science will derive not only unusually clear, concrete approaches to the development of the basic modern ideas but will be delighted with the teaching ability of the writer.

There is seemingly little attempt at a unified theme and yet the seven sections, divided into Books I and II, are tied together in such a way that one does not often feel a serious break in the exposition. Beginning with the earth and its characteristics, one is led to gravitation, matter and its constitution, radiation, and the new outlook on atoms of radiation, waves of matter, relativity, and entropy in the material universe. Book II (pages 193 to 279) considers the fundamental units of life and the evolution of living forms.

The publishers undoubtedly exhibit too much optimism when they state, in the reading notice, that the book can be clearly understod by readers who have not a background of science and mathematics. The novice in science will strike many snags and foggy areas in his reading but he will perhaps enjoy the volume nevertheless. The reviewer would recommend the book for teachers of science, for college students in survey courses in science, and for the educated layman who has some background of both physical and biological science. An index would add to the value of the book. —C.J.P.

Mitchell, S. A. *Eclipses of the Sun.* New York: Columbia University Press, 1935. 520 p. $5.00.

This book is presented in a masterly fashion by one who has been a lifelong student of eclipses and eclipse phenomena. The early part of the book presents in a very clear way the early study of eclipses and gives an excellent historical background for our modern study. This is followed by an exposition of the author's personal experiences and the discussion of the methods of photographing eclipses. Then the author takes up a careful study of the structure of the atom in its relation to eclipse phenomena. A clear presentation of flash spectra in the study of eclipses and the importance of ionization are presented.

The author closes his work with the simplest explanation of Einstein's Theory of Relativity that the reviewer has had an opportunity to read. The chapters are arranged in a logical and sequential order that gives to the entire book a definite continuity. Wherever possible there seems to be an effort to avoid technical terminology which often confuses the reader. When technical terms are used, they are clearly explained.

The book is well adapted for reference work in astronomy and can be read with ease by the better students who have a fundamental interpretation of the universe.

The author is Professor of Astronomy at the University of West Virginia and Director, Leander McCormick Observatory, and the material he presents in this edition of *Eclipses of the Sun* makes a distinct contribution to the science of astronomy. —Ezra Clarence Harrah.

Libby, Margaret Sherwood. *The Attitude of Voltaire to Magic and the Sciences.* New York: Columbia University Press. 1935. 295 p. $3.75.

Voltaire was a close amateur student of the sciences and had a great deal of correspondence with the contemporary scientists of his day. To one interested in how scientific discovery has influenced the development of thought regarding some of the significant philosophical problems, this book will prove fascinating. During his life time he comments on and criticizes the physics of Descarte, Melebranche and others, popularizes the Newtonian theories, carries on some independent research regarding fire and measurement of forces, attacks all systems of geology which try to support theories of a changing earth's surface, experiments on regeneration with snails, argues with Spallanzani as to his resuscitation of the dead (rotifers), and dabbles considerably in human physiology and anthropology. His attitudes are curious mixtures of scientific reasoning and lack of it. Much of his unscientific attitudes, however, seem to arise because of the fact that when he is confronted with the choice of his own theoretical reasoning or some one else's observation he is inclined to give little credit to the observation. For example, his lack of respect for Buffon's deductions from observation of fossils and the theories of other geologists of his time.

The chapter headings are as follows: "The Scientific Education of Voltaire"; "Advice on Methods of Scientific Investigation"; "Physics, Chemistry and Astronomy"; "Geology, Biology and Anthropology"; "Voltaire and Magic"; "Voltaire and Medicine." —O. E. Underhill.

READ, WILLIAM THORNTON. *Industrial Chemistry.* New York: John Wiley and Sons, Inc., 1933. 576 p. $4.00.

In the twenty-seven chapters of this book, the author aims to accomplish two important things. In the first ten chapters he gives a picture of chemical industry from the engineering and the economic points of view. In the remaining chapters he describes in concise and interesting fashion, the processes involved in practically all important chemical industries. The emphasis throughout is rather upon the problems involved in profitable production rather than upon the chemical nature of the process, although the latter consideration is by no means neglected.

Compared with some of the older works in the field, this book seems a definite step in advance. The author consulted authorities in every field of chemical industry represented and submitted each chapter to authorities in the respective fields for criticism and suggestions. Consequently, one may accept the material presented as being as nearly technically correct as variations in practice will permit. The illustrations consist almost entirely of diagrams obtained from the industries concerned, and are an outstanding feature of the book.

The author states that the book is intended not only for students and teachers of chemistry but also for business men who sometimes need a condensed statement about a chemical process or product. It is the opinion of this reader that the book will serve the needs of the great majority of such individuals admirably. The criticism may be advanced by some that the book does not always discuss the chemistry involved in sufficient detail to make perfectly clear just what takes place in the process. There are relatively few chemical equations used, and the discussion centers in the main about what is done in carrying out the process commercially rather than the chemistry involved. Except for this possible objection, the book is a careful comprehensive survey and a substantial contribution in its field. The publishers have done an excellent job as regards printing and format and are to be commended. —V.H.N.

HAYNES, WILLIAMS. *Chemical Economics.* New York: D. Van Nostrand Company, Inc., 1933. 310 p. $3.25.

The author states the purpose of this book to be "to set forth clearly the economic principles that underlie the making and selling of chemicals." He approaches the task from two fronts, (a) the economic foundations of the chemical industry and (b) its historical background. In the first part, the use of chemicals, methods of production and distribution, and the factors which influence the market value of chemical products are discussed. Part II begins with the industrial revolution, and discusses among other matters, the influence of the World War, cartels and mergers. The book is well illustrated with striking photographs of chemical industry, and with portraits of chemists and captains of chemical industry.

This book is one which should be read by every undergraduate and graduate student who expects to work in the field of industrial chemistry. It gives an insight, in clear, interesting language, of an aspect of chemistry with which even many chemists are too unfamiliar. Every student of chemistry and worker in the industry will have a better understanding of what chemistry really is, and its place in our modern world for having read this work. It is, for the most part, not too technical for the average educated layman to read and enjoy. There are chemical terms used, to be sure, but these are not usually unfamiliar to one who has had even an elementary course in chemistry. The book will be of greatest value, however, to the chemical profession itself. —V.H.N.

RIDGLEY, DOUGLAS C., AND GISSON, J. SULLIVAN. *Studies in Economic Geography.* Bloomington, Ill.: McKnight and McKnight, 1935. 128 p. $0.48.

This is a workbook for high-school and college courses in economic geography. Individual student activity is emphasized. The workbook includes more than 200 maps and graphs. Each unit is introduced by reference to many possible sources of information. There is a unit on each of the principal crops and industries —C.M.P.

FASTEN, NATHAN. *Principles of Genetics and Eugenics.* Boston: Ginn and Company, 407 p. $2.80.

The author of the book has made a definite attempt to produce a work simple enough for the purposes of general education and at the same time so accurate and so up-to-date as to serve effectively as a basic text in an elementary course for biology majors.

The story of the book is interestingly written and thoroughly documented. The organization is somewhat unusual and stimulating. The cell is discussed in the fourth chapter and Mendel's laws in the tenth instead of earlier in the text. The reader is well oriented in terms of both the need for genetic information and its historical development before the more technical aspects of the science are discussed. Very simple mathematics are used.

Approximately sixteen per cent of the printed matter is devoted to a discussion of eugenics. Although ably done, this space allotment seems inadequate for the purposes of a general course.

The effectiveness of the book as a text will be marred for some teachers by the lack of suggested problems, questions, activities, or readings at the close of the chapters.

The book possesses an adequate bibliography, glossary and index.

This book is recommended as an excellent basic text for elementary courses.

—M. L. Robertson.

Borradaile, L. A., Potts, F. A., Eastham, L. E. S., and Saunders, J. T. *The Invertebrata,* New York: The Macmillan Company, 1935. 725 p. $4.00.

"This book is intended for the use of students who have completed a year's study of the principles of zoology and of the anatomy and physiology of a series of vertebrate types such as is provided by any of the several elementary textbooks in use in this country." A comprehensive scientific discussion of the invertebrates is made which includes a statement of the morphological characteristics and the detailed anatomy of each specific group.

The text, which is a second edition, has been revised to include recent research data and additional subject-matter material. There are numerous diagrams showing the anatomical structures. A bibliography is not included.

—Edith M. Selberg.

Wade, J. Thomas. *A Measurement of the Secondary School as a Part of the Pupil's Environment.* Contributions to Education, Number 647. New York: Bureau of Publications, Teachers College, Columbia University, 1935. 68 p. $1.50.

This is a doctoral dissertation which has finally resulted in scales to use in evaluating secondary schools with reference to their desirable contributions to the environment of pupils. A long scale of 100 items, a short scale of 32 items, and a third scale especially for large schools, also including 32 items, have been developed. Evaluation is based upon expert judgment refined by eliminating items which did not have high correlations with total scores.

The scales should be helpful in evaluating high schools from the standpoint of features which desirably enrich the pupils' environment. Representing samples of many such features, the author cautions against their use as additions to existing features to make the school rate high. They are to be used solely as means of evaluating present schools as they are. —A.W.H.

Morrison, Edwin and Morrison, S. Elisabeth. *Experimental Physics.* Philadelphia: P. Blakiston's Son and Company, Inc. 1935. 235 p. $2.00.

This is a laboratory manual for college use with spaces for students to record observed experimental data. The object of experimental work in physics is not so much to gain facts and laws as it is to gain a "Physics' technique." Laws, principles and facts in elementary physics can be gained from textbooks, but the "power to observe nature, to set up experimental conditions, to manipulate mechanical mechanisms, and to organize and formulate one's mental processes in accordance with nature" can be gained only by active experience in the laboratory. There are 65 experiments and 189 illustrations. A helpful discussion of significant figures is found at the beginning of the work and a table of logarithms at the end. —W.G.W.

Bunker, Frank Forest. *The Junior-High-School Movement—Its Beginnings.* Washington, D. C.: W. F. Roberts Company, 1935. 427 p. $2.50.

According to the author, Chapters II to IX, inclusive, of this book are a reprint of *Reorganization of the Public School System,* published originally by the United States Bureau of Education in 1913. This ran through eight editions totaling 10,000 copies. It is now out of print. Chapter I is an addition to the original printing given to clarify and explain some of the "more intimate facts respecting the Berkeley undertaking." The book is important because it gives an account of the pioneer movement toward junior-high-school organization occurring in the Berkeley school system between 1908 and 1912.

Chapters II to VI, inclusive, give an historical account of the development of the American school system showing trends toward a functional reorganization. Chapters VII to IX, inclusive, give an account of the developments in Berkeley while the reorganization was being effected. They explain details of the plan adopted in Berkeley.

The author regards the 6–3–3 plan as representing three distinct cycles in pupil development and curriculum reorganization was carried on to meet the needs of pupils in each of these cycles, respectively.

The book may be read with profit by all teachers who desire to see the part they may play in accomplishing the objectives of a modern school system built on the 6–3–3 plan.

—A.W.H.

Shah, N. M. *Elementary Chemical Theory and Problems.* Dharwar, India: Karnatok Printing Works, 1934. 145 p.

This publication is an effort to meet the advanced needs of students in general chemistry at Karnatok College. Each chapter presents briefly the main principles involved in the study of the topic and then proceeds to show examples of solving quantitative related problems. Then follows a number of problems which call for the use of the principles. Chapter titles are: "Laws of Chemical Combination," "Gas Laws," "Equivalent Weights," "Gay-Lussacs Law," "Molecular Weights," "Atomic Weights," "Reacting Quantities from Chemical Equations," "Electrolysis," "Volumeter Analysis," "Diffusion of Gases," "Solubility," and "Quantitative Organic Analysis." The small volume gives an interesting comparison of requirements in general chemistry at Karnatok College and in our own colleges. —C.J.P.

WRIGHTSTONE, J. WAYNE. *Appraisal of Newer Practices in Selected Public Schools.* New York: Bureau of Publications, Teachers College, Columbia University, 1935. 117 p. $1.50.

In this comparison of "new-type practices" with "standard practices" the weight of evidence favors the former. This is true in both elementary and secondary schools.

In the "standard-type school practices," the science subjects (for example) are treated as isolated units. The assignment-recitation teaching is used following a textbook. Emphasis is on mastery of facts. In "newer-type school practices" the subjects are integrated under natural science and natural sciences are correlated with other curriculum courses. Pupil's interests, purposes, and attitudes are principal considerations of the teacher.

In the appraisal of practices in natural science, "intellectual factors and outcomes" were measured by administering the Cooperative Tests, Form 1933, for general science, biology, physics, and chemistry. "Dynamic factors" were measured by a test of natural science beliefs and attitudes. Pupil participation as indicated by initiative, responsibility for assignments, use of memory in responding to questions based on textbook were measured by direct observation.

On all counts the pupils in the newer type schools were superior. They made higher scores on the tests, and observations in the classrooms showed that pupil performance and teacher performance were superior.

Similar comparisons are reported of work in American and European history, reading, language usage, literary acquaintance, French, Latin, and the various divisions of mathematics. Only in American history and intermediate algebra did the pupils in the standard schools score higher than pupils in the new type schools. In several instances, however, the differences are not statistically significant.

The techniques which are described in some detail seems to be valid but not adequate. A factor, probably of considerable influence, which seems difficult to rate is enthusiasm of the teachers. Driven by the enthusiasm of trying something new, teachers put forth maximum effort. Routine procedure with minimum effort characterizes the standard type. To this reviewer, it seems reasonable to guess that the use of more adequate measures would reveal larger differences favoring new-type practices than seem to be shown in this pioneering and worthy work of appraisal.

—S. R. Powers.

RADLEY, J. A., AND GRANT, JULIUS. *Fluorescence Analysis in Ultra-Violet Light.* New York: D. Van Nostrand and Company, Inc., 1935. 326 p. $7.00.

Science involving the use of fluorescence particularly for analytical purposes has taken great strides within recent years. This book gives not only an authoritative account of the theory and technique of fluorescence analysis, but also its many applications in science and industry. Many illustrations and Luminograms are included. In chapters covering the practical applications, we find drugs, foods, fuels, leather, criminological work, gems, museum work, paints, paper, rubber, textiles, and waters and sewage. This comparative new field in science deserves the attention of science instructors because of its increasing importance in matters closely relating to daily life.

—W.G.W.

SCHAUB, EDWARD L. (Editor). *William Torrey Harris.* Chicago, Ill.: The Open Court Publishing Company, 1936. 136 p. $1.25.

This volume contains essays and addresses presented in commemoration of, in 1935, the centennial of the birth of Dr. Harris who, for 17 years preceding 1906, presided over the Bureau of Education in Washington, D. C. Dr. Harris was both educator and philosopher. The book also contains a very complete bibliography of books and articles about Dr. Harris.

—W.G.W.

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